october 1950

the tech engineering news

Kowalski

Compact industrial television system—developed at RCA Laboratories—lets us see the unseeable in safety!

Eye-witness reports from a fiery furnace!

Something's gone wrong in a big blast furnace, and heat is too high for engineers to approach. Focus the Vidicon camera of an RCA Industrial Television System on the flames and the fiery furnace can be studied in comfort on a television receiver.

This is only one suggested use, for RCA's compact industrial television system is as flexible as its user's ingenuity. "Eye" of the tiny camera—small enough to be held in one hand—is the sensitive Vidicon tube. The only other equipment needed is the Vidicon camera's suitcase-size control cabinet, which operates anywhere on ordinary household current.

The Vidicon camera could be lowered under water where divers might be endangered—or stand watch on atomic reactions, secure from radiations. And it is practical to arrange the RCA Industrial Television system so that observers can see a *3-dimensional picture* . . . real as life!

* * *

See the latest wonders of radio, television, and electronics in action at RCA Exhibition Hall, 36 West 49th St., N. Y. Admission is free. Radio Corporation of America, Radio City, New York.

Continue your education with pay—at RCA

Graduate Electrical Engineers: RCA Victor—one of the world's foremost manufacturers of radio and electronic products—offers you opportunity to gain valuable, well-rounded training and experience at a good salary with opportunities for advancement. Here are only five of the many projects which offer unusual promise:

- Development and design of radio receivers (including broadcast, short wave and FM circuits, television, and phonograph combinations).
- Advanced development and design of AM and FM broadcast transmitters, R-F induction heating, mobile communications equipment, relay systems.
- Design of component parts such as coils, loudspeakers, capacitors.
- Development and design of new recording and producing methods.
- Design of receiving, power, cathode ray, gas and photo tubes.

Write today to National Recruiting Division, RCA Victor, Camden, New Jersey. **Also many opportunities for Mechanical and Chemical Engineers and Physicists.**

RADIO CORPORATION of AMERICA

World Leader in Radio—First in Television

Product

..FOR BETTER LIVING

ALCOA
FIRST IN
ALUMINUM
The light metal that lasts

A BETTER KIND OF SCREENING *made of Alcoa Alclad Aluminum. Each wire is a strong alloy core combined with a highly corrosion-resistant outer layer. Result: a lasting screening, that will not weather-stain sills or siding. Cost: no higher than you're used to paying for good screening. Worth asking for, to install in your present frames, or in new aluminum-framed combination screen and storm windows.*

Story

BEHIND THE PRODUCT

DISCOVERY WHILE SHAVING. To a certain Alcoa metallurgist, the past few weeks' research seemed futile indeed as he faced his mirror one morning in the late twenties. This problem was a sticker: Army and Navy planes demanded a new kind of aluminum; just as strong, but far more impervious to salt spray and weather . . . Suddenly, as he squeezed the last bit of shaving cream from the tube, a message flashed. He wrapped the empty tube around his finger. Yes . . . a core of strong aircraft alloy . . . like this. An outer layer of pure, highly corrosion-resistant aluminum . . . like this!

Hastening to the laboratory, he tried out his new idea. It worked! Tests proved it to be everything he hoped it would be. Then he collared the boss roller in Alcoa's sheet mill. Quickly, he explained how this new, more useful form of aluminum was to be made. "Can you roll it, Dan?" the metallurgist asked anxiously.

"Sure we can roll it!" grinned the big, capable man in overalls. Soon a sheet ingot of high-strength alloy, sandwiched between two thinner slabs of almost pure aluminum, was slamming through the shining rolls. It grew wider, thinner at every pass—a sandwich, welded by the tons of pressure into a single unit. Finally, there emerged a new, protected kind of aluminum sheet. We called it "Alclad" Aluminum. And it came to be a mighty factor in America's air power. Most military and civil planes wear this strong shining skin.

We learned to make it into rods and tubing, even to draw it into fine wire. And thus, among many other things, a better kind of screening was born.

Moral

FOR THINKING PEOPLE

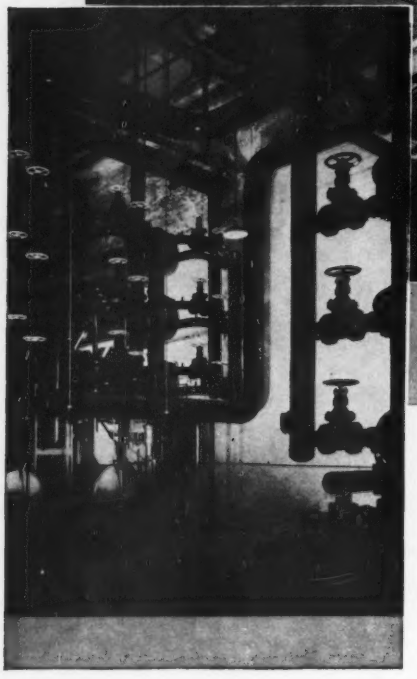
BECAUSE FREE COMPETITION *demands constant improvement, Alcoa stockholders backed this metallurgist and his fellow researchers, until their perseverance found the answer. Others stood ready, in plants, sales offices and management, to introduce the new Alclad products. After 18 years, this better product is still creating new jobs, and helping America toward better living, in home, farm, and industry. Seems like a good system for all concerned.* ALUMINUM COMPANY OF AMERICA, *742 Gulf Building, Pittsburgh 19, Pa.*

ALCOA

In the World's Biggest Refrigerator

JENKINS VALVES stand guard

against operating failure



More than 1000 Jenkins Valves are used for control of steam, water, brine, in piping systems for refrigeration, heating, fire protection, sanitation and other essential services.

THE 22-acre Alford Refrigerated Warehouse in Dallas, Texas, is "the biggest refrigerated area this side of the polar ice cap." With millions of dollars worth of perishable goods entrusted to constant cold, valves, like all other mechanical equipment, must perform with unfaltering efficiency.

For this reason, and with the further objective of low maintenance costs, the Alford management standardized on Jenkins Valves. More than a thousand are used along the miles of vital pipelines.

Jenkins builds extra endurance into valves — proved time and again by low upkeep cost records in every type of service. Future-minded builders know this, and choose Jenkins Valves — yet, they *pay no more*, despite the extra value. The Jenkins Diamond is their guide to valve economy . . . for new installations, for all replacements. *Sold through leading Industrial Distributors everywhere.* Jenkins Bros., 100 Park Ave., New York 17; Jenkins Bros. Ltd., Montreal.

JENKINS

LOOK FOR THE DIAMOND MARK

VALVES

SINCE 1864

TRADE JENKINS MARK

Jenkins Bros.

Photo by USAF Air Materiel Command

Glass face that can take a bath of fire

The man you see here can wade into the hottest part of a gasoline or oil fire and stay to put it out.

He is wearing the latest in fire-fighting dress, developed by the Engineering Division Laboratories at Wright-Patterson Air Force Base, in Dayton, Ohio.

Designing the suit—to protect the wearer against heat up to 2000° Fahrenheit—was a tough enough problem for Air Force scientists. But once they had solved this by using layers of glass fabric, nylon, and metal foil, the problem presented by the visor for the fire-fighting suit was yet to be worked out.

Was there a material transparent enough to let the fire fighter see, yet fire-resistant and fire-repellent enough to let him face up to a 2000° Fahrenheit blaze?

That question was put to Corning Glass Works, and the answer was a fire fighter's face made of Corning's Vycor Brand 96% silica glass.

Two thin panels of 96% silica glass—the Corning glass that can be heated till it glows and then plunged into ice water without breaking—are used to make the visor. And their inner surfaces are coated with thin, transparent films of gold.

This glass transmits cool, visible light, allowing the fire fighter to see. The gold film blocks the hot, invisible rays by reflecting them outward. A small dead-air space between the glass panels prevents conduction of heat through the glass from the hot, burning gases.

We hope this special use for Corning's 96% silica glass will remind you that today—because of Corning research—you can use glass in many ways that you may never have thought of before.

Throughout industry, Corning means research in glass—research which has made glass a material of practically limitless uses. That's a good thing to remember when you've finished college and started working. Then, as you plan new products or processes, we invite you to call on Corning before the blueprint stage. *Corning Glass Works, Corning, New York.*

CORNING
means research in glass

BIGNESS

COMES IN HANDY!

In Peace—In War!

ON December 7, 1941, the Japs launched their "surprise attack" on Pearl Harbor . . .

On June 25, 1950, the Reds launched *theirs* on South Korea . . .

And today, as in 1941, 1942 and 1943, it is the enemy's turn to be surprised—

At the ready strength of our competitive free-enterprise industries . . . at the speed of their productive mobilization!

Socony-Vacuum, one of America's big companies, geared to peacetime competition under the U. S. business system, has been steadily growing stronger—looking ahead, plowing back—building for future needs.

And today in Petroleum this bigness is coming in "handy"—*vitally* handy as our nation goes on a war footing.

For example, Socony-Vacuum's world-wide producing facilities have more than doubled—and refining capacity has increased nearly 50% since 1942—big build-up year of World War II.

Today, Socony-Vacuum has pledged its all-out efforts to meet our military and civilian needs. We believe the free system which has enabled us to become a big company, which makes our nation the greatest in the world—is worth serving and protecting to the limit of our resources and abilities.

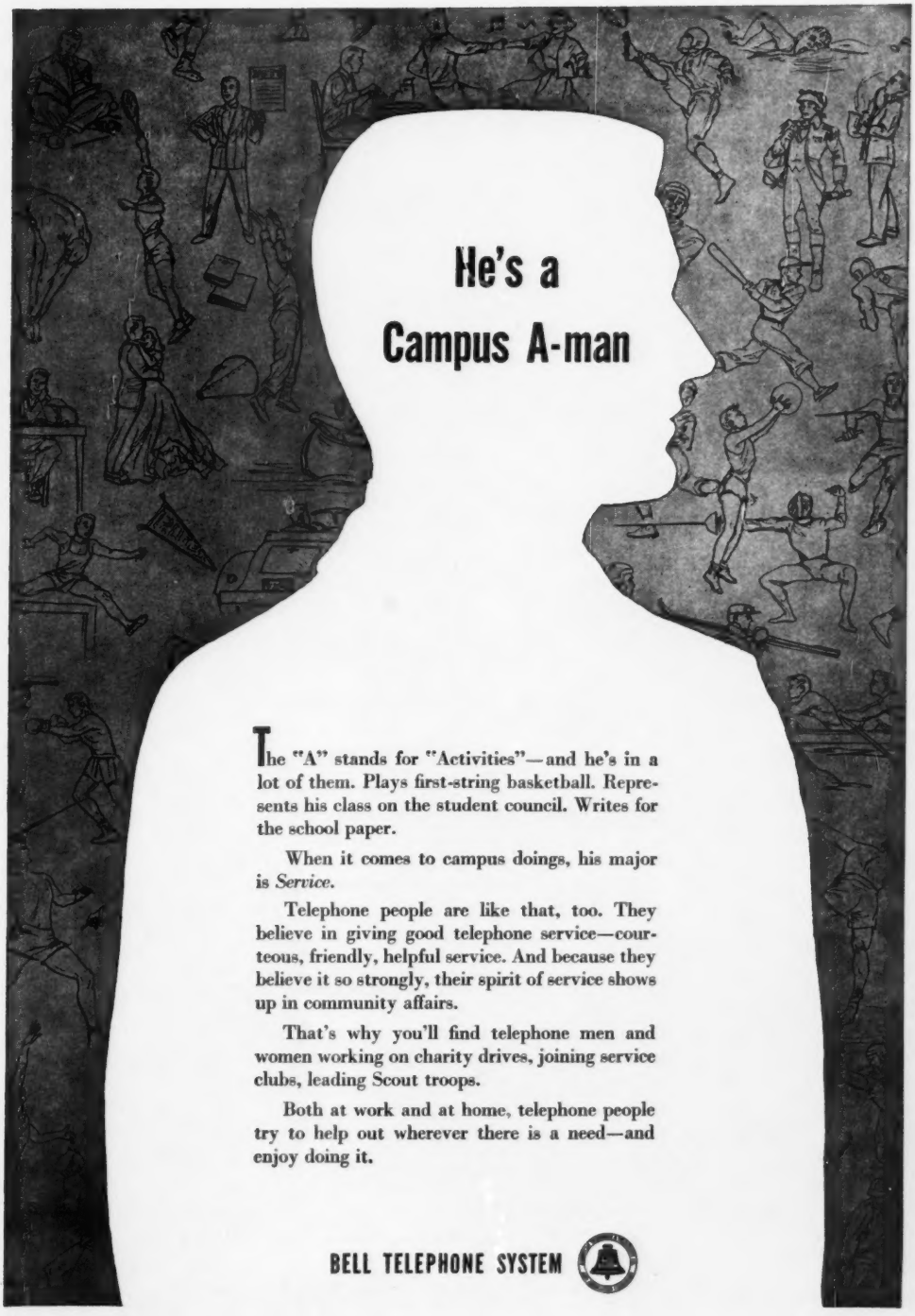
The Flying Red Horse Companies

SOCONY-VACUUM OIL COMPANY, INC., and Affiliates:

MAGNOLIA PETROLEUM COMPANY • GENERAL PETROLEUM CORPORATION

SOCONY-VACUUM

BIGNESS SERVES AMERICA—PROTECTS AMERICA!



He's a Campus A-man

The "A" stands for "Activities"—and he's in a lot of them. Plays first-string basketball. Represents his class on the student council. Writes for the school paper.

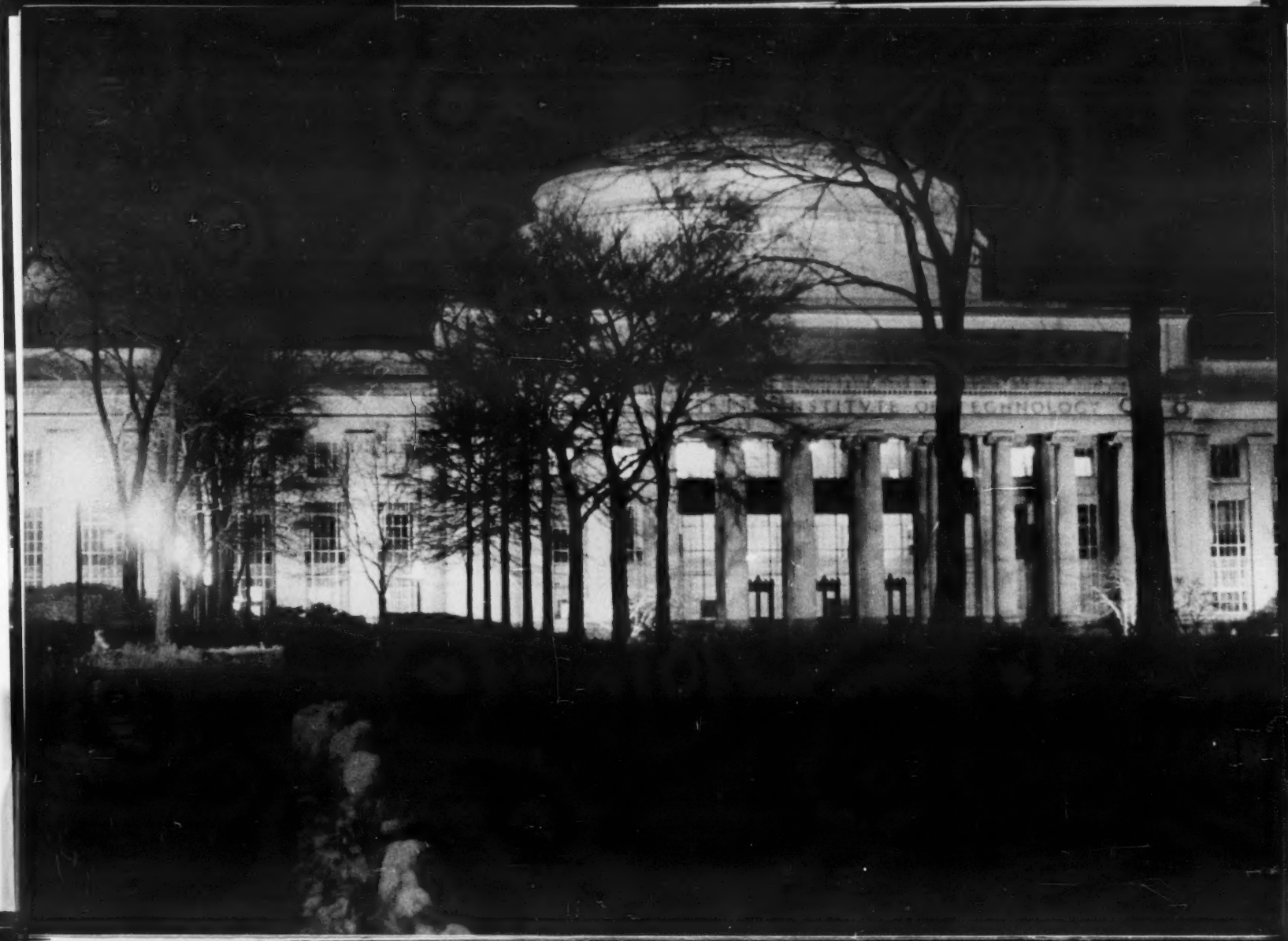
When it comes to campus doings, his major is *Service.*

Telephone people are like that, too. They believe in giving good telephone service—courteous, friendly, helpful service. And because they believe it so strongly, their spirit of service shows up in community affairs.

That's why you'll find telephone men and women working on charity drives, joining service clubs, leading Scout troops.

Both at work and at home, telephone people try to help out wherever there is a need—and enjoy doing it.

BELL TELEPHONE SYSTEM



tech engineering news

October 1950
Vol. XXXII No. 1

What's Wrong With Activities? 8
By Andrew Price, '50

Order Out of Chaos 10
By Charles Saltsman, '52

Let's Bring Music Up to Date 12
By Arthur Wasserman, '51

The New National Science Foundation 13
By *T. E. N.* Staff

The Earth's Safety Valves 14
By John Mathis, '53

Can Gravity Be Abolished? 16
By John C. Cook

Cover Design by Charles M. Saltsman, '52

Published monthly during the school year at Walker Memorial, Cambridge 39, Massachusetts, by the undergraduates of the Massachusetts Institute of Technology. Entered as second class matter, at the Post Office, June 1, 1920, at Boston, Massachusetts under the Act of March 3, 1879. Copyright 1950 by The Tech Engineering News. Subscription per year $1.50. Foreign $2.25. One copy 25 cents.

what's wrong with activities?

Why, with 106 Activities, Do We Have a Participation Problem?

By Andrew Price, '50

Tech students just do not go out for activities as strongly as they might. Each year finds some new method to induce the incoming freshmen to go out for activities. We have Frosh Camp, the *T.C.A. Handbook*, *Tackling Tech*, Big Brother plans, and now the Freshman Coordinating Committee. But all of our attempts to increase participation have been directed at the students. Are we so naive as to think that what we are offering is so wonderful, so perfect, that it must be the students who require the attention? In my thesis, I have assembled facts which point the way to other solutions.

With the *T. E. N.* poll of student life as background, I conducted indirect interviews with over two per cent of the undergraduate body. One of the things I was looking for was the reason that a student joined a particular activity. In sixty-three instances, I was able to gain this information. I grouped the reasons given into five classes. Of course, reasons for joining professional honor societies are omitted from this tabulation.

Motivation	*Number Claiming It*
Prestige	21
Interest	18
Friends	16
Hobby	6
Experience	2
	63

Prestige is obviously an important cause for joining an activity. It can, in my estimation, be worked to advantage. The motives and hopes of the student entering the activity are translated into the motives and hopes of the activity group as a whole. The prestige and power gained by the activity are again translated into increased availability of personnel and success of the activity venture. In discussing the application of the prestige factor, I shall consider Class *A* and Class *B* activities separately, since each seems to have unique problems.

Voo Doo breaks ground for new Senior House sixteen hours before Dr. Compton.

There are at this writing, seventeen actual and provisional Class *A* activities at the Institute, including the three organizations supposedly representing the living groups. The heads of these activities have seats on the Institute Committee. The majority of the Class *A's* are large in purpose, and require a large group to spread the work, so that lack of personnel is a rather common ailment.

Of the seventeen Class *A* activities, only two as a rule have no manpower problem: Voo Doo and Tech Show. Both organizations have reputations outside of school as well as inside, and both have benefits to the lowly just-plain-number. Voo Doo has its many parties, its office beer and free telephone, and its publicity stunts which give its membership a place in the public eye. The Tech Show is also quite able, through sales and the show, to place its personnel in the limelight.

The other Class *A's* have no prestige awards for endeavor other than titles for their officers and a seat on Inscom for the top dogs. The latter is not to be taken lightly. Concerning the recent request of the Lecture Series Committee for Class *A* status, the investigating committee said that the "prestige of Class *A* status will enable the L.S.C. to attract even more competent men for work on the committee." Since the only material difference between Class *A* and Class *B* is the seat on Inscom, it seems that this must be the source of the prestige.

Class *B's* have been classified as special interest groups. I find some faults with such a definition, especially when one tries to exclude all Class *A's* from such a category. But it is true that since the Class *B's* have no seats on Inscom, with accompanying prestige, one of the strongest motivations for joining is denied the Class *B's*. Therefore interest and friends must be the strongest reason for joining Class *B's*. This is hardly uncommendable, but all other things being equal, would a student choose Tech Show or Dramashop — the four Class *A* publications or the three Class *B's*?

Class *B's* are also hindered by lack of communication with the student government, the student body, and each other. While some prefer to be left alone, many have voiced complaints about such anonymity. Some cannot afford extensive publicity campaigns to let students know of their existence. Some do not have the facilities, or the knowledge, to be in touch with Inscom or its subcommittees which are always passing edicts concerning the Class *B's*. These lacks are not beneficial to these activities.

Since the Inscom is such an important part of the prestige factor, let us take a quick look at its organization. The Committee has at present thirty-eight

Tech Flying Club has its planes at Bedford.

members, who can be arranged in three groups: twelve elected by the student body, nine heads of government committees, and seventeen heads of Class *A* activities.

There are three points to be made concerning Inscom. First, Inscom membership has increased by ten members in the last five years. Secondly, the largest group of its membership is not elected by the students, and, in fact, the Class *A* activities control Inscom, rather than the committee controlling activities. Thirdly, the trend toward control by activities is on the increase, as shown by a recent attempt of the Finance Committee to gain more power, and the request of the International Activity Committee for Class *A* status. It has also been commented by some members of Inscom that meetings last longer and accomplish less than previously.

What can be done? It is important to the activity that members have the capabilities and talents needed by the group. But the would-be member cannot know the capabilities needed from the name of the organization. I approached sixty-four of the Class *A* and *B* activities and student government committees with a questionnaire designed to find the methods of gaining new members and their relative effectiveness. Forty-one replied with the results tabulated below:

	Number using it:		
Method	*Class A*	*Class B*	*Government Committees*
Smokers	10	3	3
Personal contact	4	13	5
Freshman Camp	6	0	0
Posters	6	11	3
The Tech	1	1	2
Letters	0	3	3
The most effective method:	*Number claiming it:*		
People coming in	5	0	1
Freshman Camp	4	0	0
Personal contact	2	4	9
Smokers	1	0	0
Word of mouth	1	0	0
Letters to fraternities	0	1	0
Posters	0	1	3
Having good meetings	0	1	4
No problem	0	2	0

This shows the many methods of publicity utilized, with the comparatively high degree of success by personal contact and people coming in. This seems to imply that the activities could do a better job at publicizing themselves, but when one notes the high frequency of smokers and posters with a low degree of success, one wonders how else an activity can spread information about itself. I believe one answer is found in the reply that the Student-Faculty Committee made to my questionnaire. I asked, "In what manner do you find you recruit the most members?" They answered, "By having the committee such that the members will feel that they are getting something out of what they are doing, then seeing that the Freshmen know what these things are. In other words, the committee must build a reputation over the years of importance and prestige."

Another possibility is to expand activities more into the public eye. The exhibits of the A.I.Ch.E. and the Tech Model Railroad Club are excellent examples of what I mean. It is not only important that the small portion of the student body having a specific interest be aware of it, but also that the small portion can have their efforts rewarded by recognition by placing them before the general student body.

The prestige factor that is limited to the activity and its membership could be improved. In most activities there is a definite need for big and little wheels plus a lot of plain members. If the activities were more organized and the hierarchy were better defined, the plain member can see where he is going, and his satisfaction in the group should be enhanced. By spreading responsibility, interest can be increased among the lower members.

The means of communication with the living groups would bear some examination. Sending letters to fraternity presidents is most effective, but I question the value of sending letters to the Dorm Committee or the 5:15 Club. Reaching the commuters is especially difficult.

I have found that any discussion of prestige is tied directly to the status of an activity, and the only major

Tech Show.

difference between Class *A* and Class *B* is the Inscom seat. The size and purpose of the activity is not a reasonable distinction between them, but merely a factor considered by the Institute Committee in granting *A* status to a *B* activity.

We have seen also that Inscom is getting larger and larger as more subcommittees are formed and more

(*Continued on page 22*)

order out of chaos

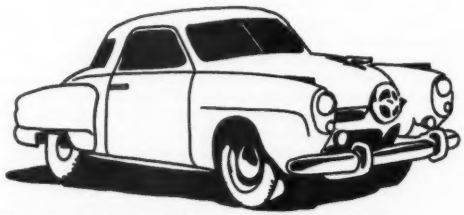
You and Industrial Design

By Charles Saltsman, '52

During the months of February and March, 1950, a series of lectures, sponsored by Harvard University, M. I. T., and the Society of Industrial Designers, was given at Harvard's Baker Library. The topic — Industrial Design, which, in spite of its great importance, is one of the most unknown and misunderstood subjects that one could hope to find. True, as a profession it is the youngest in the world, and one of the smallest. But if its size is small, its scope is great: in this country it provides the nucleus about which modern industry revolves. A relatively few designers are today responsible for the appearance of many billions of dollars' worth of manufactured articles, articles that range from ashtrays to airplanes. Many of these men would have difficulty in finding a home or building in the United States in which one or another product that they had designed is not in use. And yet it is surprising how many people either have never heard of Industrial Design, or have practically no idea of its importance. It was with the hope that more people would become acquainted with the designer and his work that the lecture series at the beginning of the year was held, with such well-known speakers as Walter Dorwin Teague, Raymond Loewy, and Henry Dreyfuss. And perhaps it was hoped, as well, that of those who attended, a few would decide to follow in the footsteps of these men, and become designers, for the field is far from filled, and the future bright.

What, more specifically, is Industrial Design? Many definitions of the term have been offered, but perhaps it is explanation, rather than definition, that is needed. Today, every businessman, every salesman, and every industrialist knows that a product, regardless of its mechanical perfection, will not move from the showroom floor unless it is attractive in appearance. This has not always been the case; before the depression of 1929, the manufacturer sought to increase the sale of his product, not through design, but by reducing its price. But the depression cut the consumption of manufactured goods so drastically that industry had to find a new way to sell its products and so to remain in competition for the dwindling market. The new way was to introduce art into the factory, and so to make stoves, refrigerators, automobiles, and radios that would not only work efficiently, but which would be attractive as well. The man who took the work of the engineer and put it together in a way that would please the eye of the customer became known as the Industrial Designer. During the past decade he has been called upon for help from every quarter, until today he finds himself planning factories, offices, homes, and machinery, as well as consumer goods. In this present capacity, he overlaps somewhat with the architect, the city planner, the machine designer, and the interior decorator, with the result that his job, Industrial Design, can no longer be defined in clear and simple terms.

To attempt to discuss all of the aspects of Industrial Design is virtually impossible. Many large and detailed volumes have failed to do this, and many writers have gone astray by trying to give a broad picture of the new profession. It is not difficult, however, to single out a few examples of the designer's work and through a brief description of these, give a reasonably complete idea of what the whole subject of Industrial Design is about. It should be kept in mind that though most of these examples will be three-dimensional machine products, the designer also works with such things as furniture, fabrics, buildings, and glassware. But all of these present special problems which are not typical of those which the designer must face, and therefore will not be included.



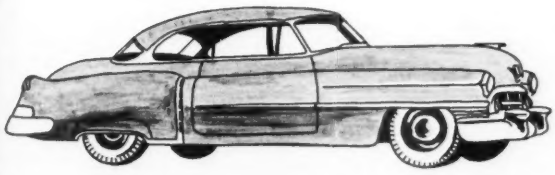
The Studebaker — sleek, trim, fast (too fast?).

To begin with, there are essentially two types of designer: one who works exclusively for a company, and is included, like any other employee, on that company's payroll, and the other, who works independently, and for a number of firms. Of the first, General Electric might be cited as a good example, having a design department which employs fifty people, and which designs everything from toasters to locomotives. The second would include the large firm of Raymond Loewy Associates, whose designs appear in a wide variety of products, the sales price of which exceeds a billion dollars each year, and the smaller business of one or two designers handling but a small fraction of that. These independent offices receive their incomes in the form of fees for each job, or in retainers, paid to

The Flatiron. A little design makes a big difference.

them by manufacturers who continually require their services. It is not uncommon, also, for large firms with their own design departments to call in an independent designer from time to time to help with the major problems which may appear.

But how does the designer operate? Where does he obtain his information that leads him to adopt one design over another? And what are his limitations? To answer these questions, let us see how the designer



The Cadillac — a spoiled design.

goes about redesigning some article. Suppose, for example, that our designer is telephoned one morning by an official of the Lightning Electric Company. Lightning's flatiron, it seems, has not been selling too well in the past year or so, and the executives of the firm have begun to wonder whether or not the design might be the reason. A consultation is arranged to talk things over, and to let the designer see the flatiron. At the meeting it is decided that the price is low enough, that the advertising and sales staff are doing their best to sell the iron, and also, perhaps, that the iron really does not look too bad. In addition, there is nothing wrong mechanically. The designer agrees to try to find out what the trouble is. He has noticed that the shape of the handle, if changed, might be more comfortable to hold, but this seems hardly reason enough to retard its sales. Therefore, he sends out a number of men to talk with stores handling Lightning products, and housewives who own a Lightning flatiron. From this sort of informal poll, he finds that the iron is too heavy for a woman to lift easily, that the electric cord is too short, and that because of the iron's shape and size, it is difficult to see part of the piece that is being ironed. With this data, the designer talks things over with his staff, and rough sketches of a new iron are made. Little by little these sketches become finished drawings and blueprints. At last, when one or two designs are decided upon as being the best, these may be made out of wood or clay to show to the executives of Lightning. At the next meeting with them, the models and drawings are shown, and the new design decided upon.

It is probably needless to say that the designer must use both tact and psychology in his first dealings with Lightning, but once the sales of the iron have gone up, he is assured more lasting relations with the company. It is very likely that before long the president will show up in the designer's office with last year's vacuum cleaner under his arm.

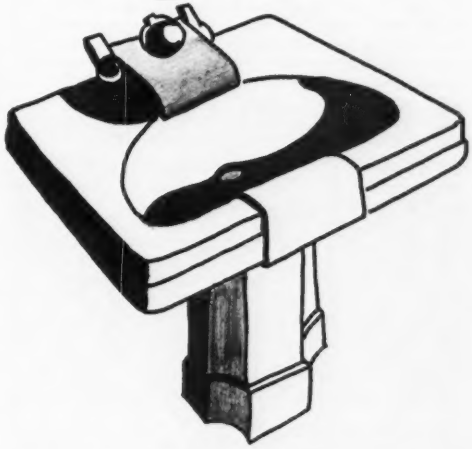
A few points should be clarified. First, it was noticed that the old flatiron was not unattractive, and yet it didn't sell very well. This may often be the case; when it is, the designer must not forget that the first consideration is to make sure that the product functions in the best possible manner. Design will follow. Second, the designer must never forget prices. His motto must always be: a better product at a lower price. To this end he must possess a vast store of knowledge about materials, engineering principles, and the limitations of a machine. He cannot design a casting that is too expensive to produce, nor can he design a casting that is beyond the capability of the dies or of the materials.

The pros and cons of flatiron design could be carried on almost indefinitely, but little else would be learned concerning the whole picture of Industrial Design. Therefore a look into the automobile industry is in order at this point. Again, the discussion must be somewhat sketchy, and limited to two examples: the Cadillac and the Studebaker. Automobiles are a good deal more personal than flatirons, and therefore the designer must be careful in his work to take into account the likes and dislikes of the public. He must, for example, discover as best he can whether those people who will buy cars in 1951 will want more or less chrome trim than they would have had had they bought the 1950 models. He must know what new accessories have been developed within the year which, if added, will increase sales. He must consider carefully every idiosyncrasy and every prejudice of the buyer.

The newest Studebaker, undoubtedly one of the most radical automobile designs of today, is an experiment based on a very sound idea; the idea that a car should look as though it were moving even when it is parked at a curb. A machine built to move should at least look its part. Perhaps the jet-shaped grill overstresses this, and suggests, rather than motion in the range of sixty miles an hour, something built for velocities in the supersonic range. However, it is the opinion of Raymond Loewy, the Studebaker's creator, that an automobile should look light, slender, and fast. And it isn't difficult to see that he favors good visibility.

Design-wise, the new Cadillac is a rather attractive car. However, rather than being fast looking, it appears as though it might never move. Notice the drawing of this car. The front, with its long, sweeping, horizontal lines, announces to the world that this is a car that is going places. But this effect is stopped cold by a

(*Continued on page 24*)



Even the bathroom sink gets redesigned.

let's bring music up to date

By Arthur Wasserman, '51

Frequently we come across something which we accept as perfect, not because we have thoroughly investigated it and realize its faultlessness, but merely because it happened to be there when we came along and because we know that it existed in its present form for a long period of time before us. So it is with the standard system of music notation.

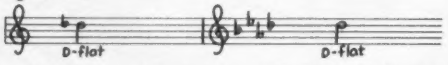
Is it not a little childish to say, "Music notation must be perfect as it now stands because it has changed only very slightly in the past three hundred years or more?" Does length of time of existence prove perfection and incapability of improvement?

Music notation is far from perfect, and I should like to illustrate this fact by revising certain phases of the standard system of notation with you, to produce a system that is, perhaps, a little less complex. First, however, let us examine a few of the difficulties of the present system.

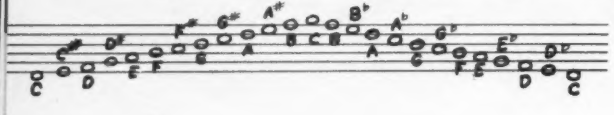
Some of the major faults of the present system with regard to simplicity, which we shall try to correct, are the use of complex key signatures (including clef signs), the use of ledger lines, and the use of accidentals. These are necessary in the present system of notation because the system is based on the eight degree major scale which, as a sole basis for harmony, was outmoded before the days of Bach and Haydn.

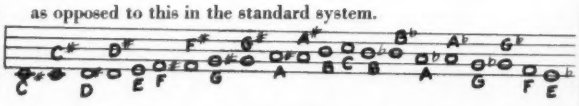
Let us examine carefully the standard staff.

We have five lines and six spaces (including the spaces immediately above and below the staff), with each line and each space representing one degree of the eight degree C-major scale and the interval between any two degrees varying between a half tone and a whole tone. To denote a tone not in the C-major scale, such as D-flat, the accidental must be used with the note D, which lies in the C-major scale. (The accidental, of course, may either be placed immediately preceding the note on the staff, or it may be incorporated in the key signature.)



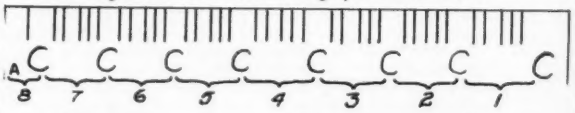
Now let us try to devise a staff which will eliminate the necessity for using the accidental in denoting the tone, D-flat (or any other conceivable note). We might, you suggest, use a staff based on the thirteen note chromatic scale. All right, then, how about adding one more line to the standard staff (giving us six lines and seven spaces — including the spaces immediately above and below the staff — or a total of thirteen possible positions in which to place a note) and letting each line and each space be a half tone interval from its neighbor. Let us also, arbitrarily, call the lowest space and the highest space C, in order to have a working basis. Now our full chromatic scale looks like this as opposed to this in the standard system.





There! We have eliminated accidentals completely. Now, however, you discover that we have limited ourselves to one printed octave and have no idea as to which of the nine or ten audible octaves it represents. If we were to try to play the note C on the piano we would not know which of the eight C's to play.

But, wait! Since we are talking about the piano, let us look at the keyboard. The highest note is a C. Suppose we divide the keyboard into octaves, each from C to C, and number them starting with "one" for the highest octave. This is roughly what we have:

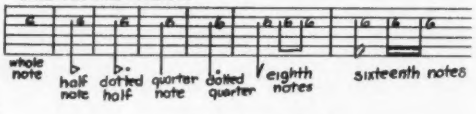


Now, suppose on our new staff we replace the heads of our standard notes with these octave numbers, to indicate the relative position of the notes in our audible range of tones.

Standard

Improved

At this point, however, it becomes obvious to us that we will have to revise our method of indicating time interval for notes, since the heads of the notes, in the standard system, are used to differentiate between the larger time intervals. Let us have the stems of the notes indicate all such intervals, and let us, therefore, arbitrarily accept the following revised set of time interval denotations.



(*Continued on page 30*)

the new national science foundation

By the T.E.N. Staff

At long last the welfare state is hitting home. On last May 10 the President approved the bill creating the National Science Foundation. This means that students of basic sciences, of which there are some at M. I. T., will receive financial aid from the Federal Government. The stated purpose of the Foundation is "to develop and encourage the pursuit of a national policy for the promotion of basic research and education in the sciences."

The bill has been batting about on Capitol Hill for ten years. Originally backed by scientific organizations, such as the National Academy of Sciences and the American Association for the Advancement of Science, the bill had to surmount many legislative obstacles, chief among which was the security issue. Naturally enough, early supporters, in the thick of wartime research, saw a need for strong protection of military secrets. But just as the emphasis on the military aspects of the Foundation waned as the war became but a memory, the security provisions grew less strict in successive versions of the bill. With the defeat of the Smith and Flood amendments, which would deny aid of any sort until the recipient was cleared by the F.B.I., the bill requires clearance only of persons concerned with defense work, while all others are merely required to sign an affidavit of allegiance. The clearance procedure will be similar to that now used by the Atomic Energy Commission — investigation of prospective recipients of aid by the F.B.I.

The new Foundation, or N.S.F. for short, is primarily a spending agency. That is, it consists of a board of men who allocate funds to carry out the purpose of the N.S.F. More about the board later, but let us first realize that "spending" means spending into private hands. The N.S.F. is specifically denied the right to run laboratories of its own. Instead, the Foundation will do its work by contracting for research and awarding scholarships. The total amount of spending, specified in the law, is one-half million the first year, and fifteen million per annum thereafter.

The research will primarily be contracted for with private laboratories — the universities. This follows a procedure already established by the Office of Naval Research, and the Atomic Energy Commission and other agencies. The significant fact here is that the N.S.F., by explicit wording of the law, will not interfere with the work of laboratories, public or private, now engaged by other government agencies. This is of course important to the universities now taking the lion's share of the Federal research dollar. M. I. T. is certainly such a school. The N.S.F. research program is thus seen to be in the way of icing on the cake.

The scholarship program, on the other hand, is really quite an innovation. N.S.F. scholarships and fellowships are to be awarded on the basis of ability alone, and the recipient is allowed to choose his school. Naturally, ability will be substantially equal in some cases, and in these events, distribution of aid is to be made equally among the states. We can judge the magnitude of the aid program at least approximately. First, let us suppose that there are five million dollars available for educational aid. This figure is possible, since there is no stipulation regarding the allocation of funds in the law. Secondly, let us suppose that five hundred dollars is the average stipend. Then plainly enough there would be ten thousand scholarship recipients. Now last year there were 2.5 million college students. If we say arbitrarily that twenty per cent are studying science, this means that one out of fifty eligibles will collect. Perhaps one hundred Techmen will be affected. Needless to say, this is only guesswork, but it shows the expected size of the program. It may be that since such a program will aid the better students, some of whom might have attended inferior schools because of finances, the net effect of the program would be increased pressure on the better schools. In this way the scholarship program differs from the G.I. Bill of Rights, whose recipients were evenly distributed in ability.

The administration of the N.S.F. funds is under the direction of an executive body called the National Science Board. It has twenty-four members in addition to a well-paid ($18,000) Director. Of course, the Board comes under the executive department of the Government, and as such, its members are appointed by the President, subject to the approval of the Senate. A good attempt to eliminate politics from the Foundation is noted in the wording of the law; qualification for Board membership includes a distinguished record in one of the fields of science or in public service. The success of such a specialized agency as the N.S.F. reflects strongly the stature of its directors, especially since the detailed policy is practically all in their hands.

It would seem that one of the greatest issues which will confront the first Board will be the interpretation of the word "basic" as applied to the type of science which the N.S.F. is supposed to cultivate. Some light may be shed on at least the intentions of the legislators by remembering the Foundation was first conceived as a remedy to the large gap between basic science in the United States and in Europe. Thus though there is certainly no sharp demarcation between "pure" and "applied," the originators of the Foundation probably meant "most basic." The problem of which is the most basic of two research problems will be a tough one for the Directors to decide. Certainly, lack of military or industrial support of a piece of work no longer is a sure sign that it is too fundamental. It may be that the N.S.F. will indeed evolve a policy of plugging the holes left by private laboratories.

Now if history is to be duplicated, there will be a great hue and cry about discrimination; why should basic science be supported and not, say, studies in economics? The answer to that one is really simple: applied science proved itself indispensable in the war, and basic science is indispensable to the growth of applied science. And if basic science can't be safely imported from Europe, we must somehow grow this product in our own backyard. The fact is, the N.S.F. is certainly discrimination, but it exists for the benefit of the country, and not the scientists as a pressure group. Not all the hue and cry can be ignored, however. In one way there is definite danger, according to Strytten writing in the *Scientific American*, that the N.S.F. scholarship will divert brainpower from other

(*Continued on page 34*)

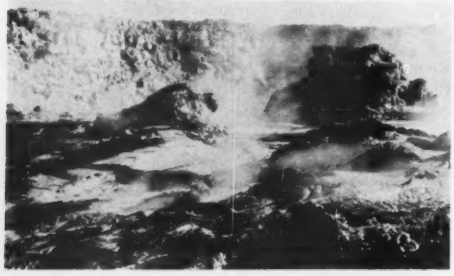
the earth's safety valves

...Volcanoes and How They Grow

By John Mathis, '53

"Once upon a time, long, long ago . . ." No, you haven't started a fairy tale, but any story of any volcano must take you even farther back into the past than the oldest myths and legends. Volcanoes sneezed dust and spat fire long before man made his appearance on earth, and primitive peoples fled before advancing sheets of flame a million years before recorded history.

When did volcanoes come? Will they continue to be formed? If they will, how often will they make their appearance?



Courtesy of Geological Society of America.

A steaming volcanic pit with thick fumes rising from hot mud.

Asking these same questions, scientists prowled about great steaming pits of scalding volcanic mud and braved the choking fumes that belched forth from the earth's interior. They were gradually rewarded with some hints to the riddle of when volcanoes erupt.

They learned that all of the great volcanoes of today were formed at the same time! It seemed as though the earth had caught some disease and had suddenly broken out with a fiery rash of craters that left permanent scars on its face. Occasionally these old scars reopen even today, and we see explosions like those that shook the earth millions of years ago. These reopenings are certainly not new volcanoes.

Strangely enough, this period of fiery activity occurred when the earth's surface was coldest, or during the last Ice Age of one to two million years ago. The thousands of cubic miles of glacial ice that covered part of the earth's surface must have presented a strange contrast to the molten lava and superheated gases that were spewed from the fluid interior.

The burst of volcanic activity which formed our present volcanoes was not the only one in the earth's history. Traces of other periods that date far back into the past have been found. Scientists quickly realized that an investigation of the periodic outbursts would provide a valuable clue to the earth's past and future.

They reasoned that volcanic activity is a safety valve that lets off excess energy from the earth's interior. If the earth were cooling off or losing its energy fairly rapidly, these natural releases of pressure would occur less and less frequently as time passes. A comparison of the intervals between volcanic cycles would thus provide a rough estimate of how rapidly our planet is radiating its inner heat into space. The rate of emission might greatly affect the time interval before the earth becomes a cold, lifeless body.

What was the verdict? It sounds impossible, but it's actually taking place — although the interval between periods of activity is not at all regular, it is quite comparable now to what it was a billion years ago! In other words, it seems that the earth's interior has about as much energy today as it did when the earth was very much younger. How can this improbable result be justified? No one knows yet, but we suspect that there are sources of internal energy that maintain the temperature of the earth's core.

But what makes a volcano erupt? One of the most noticeable clues to the solution can be found by looking at a world map. We see that the great craters appear to lie in fairly regular lines stretching great distances. One such chain extends up the Andes in South America, eastward through the Caribbean, and into Central America and Mexico. The great line of volcanoes from Alaska through the Aleutians, the Kuriles, and the Japanese islands form a similar group. Most of the world's volcanoes fall into these long, curving lines.

There even seems to be a regularity about the location of these volcanic chains. In most cases they occur near the division between a great uplifting of the earth's crust and a deep depression, such as the high North American and Asiatic continents and the deep Pacific Ocean in the case of the Aleutians. Evidently

Courtesy of Geological Society of America.

Exposure at night showing the flow of the molten, red-hot lava.

the stress of this bending cracked the earth's crust along thousands of miles.

Some of these cracks reached the surface, but others were in the lower portion of the crust. The plastic mixture of molten rock and superheated gases of the earth's interior, called magma, rushed into the subterranean fissures and formed a comparatively thin wall of fire, called a dike, that cut into the crust like a

giant sawblade. The upper edge of this dike zigzagged up and down irregularly along its length, most of it several miles below the surface. Whenever a "tooth" of the "saw" jutted close to the surface, the terrific pressure on the magma from below forced it through the overlying rocks along pipes or vents. Many vents were thrust through the crust from each weak point, and all together formed a whole system of pipes that is called a "dike complex."

The magma beneath the surface was highly charged with gas, largely carbon dioxide and water, under terrific pressure. When a vent suddenly relieved the pressure on the magma below, the molten rock acted as bottled soda water does when the cap is removed; it foamed up the pipes and spilled out on the surrounding territory. Soon the ejected dust and cinder-like solidified magma covered the area around the dike complex and built up the familiar cone that we associate with all volcanoes. The magma flows from a chamber or reservoir some distance beneath the cone.

The nature of the magma that flowed out of the pipes depended largely on two factors: its temperature and gas content. If it was heated well above its melting point and contained a large proportion of gases, it was fluid enough to run like water and flowed over the surrounding area in streams or broad floods. On the other hand, if it was cooler and contained less volatiles, it was sometimes so thick that a sheet fifty feet thick was required to make the semi-solid flow. Such viscous fluids could only ooze through the rocky vents.

Courtesy of Geological Society of America

Violent explosion in a Hawaiian crater.

The pipes would gradually cool as the pressure was relieved, and the magma slowly solidified into tight plugs. When all of the pipes became clogged, the volcano became dormant. After varying periods of time, sometimes hundreds of years or more, the pressure of the lower level of magma would again be sufficient to blow the stoppers out. With violent explosions the solidified plugs would be thrown skyward, and scalding magma and released gases would again gush forth from the cone. The sides of the cone, continually enlarged by the ash and flowing lavas, grew with each eruption and sometimes formed a great mountain peak.

But the height of the cone is limited by the length of the central dike column. When the pipes become too long, the magma is easily cooled and finally closes the vent. Other cracks appear around the base of the central peak, and magma flows from them and builds secondary cones about the greater mountain's base. Gradually the pressure on the deeper magma is relieved, more and more pipes solidify, and the volcano becomes quiet.

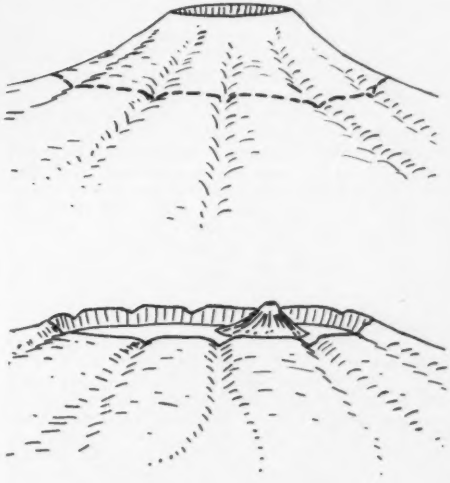
Strangely enough, many volcanoes have the entire top of their cones missing. These amputees are called "calderas," Portuguese for "buckets," because they have bucket-shaped craters that are far too large to be merely the vent for a dike. Furthermore, the slope of the cone at the edge of the crater is far more gentle than it would be if the entire cone were formed by a simple accumulation of lava and ashes. These mountains seem to have lost their heads.

Of course we first think of some sort of giant explosion to account for the demolished peak, but the volume of rock in the missing portion is far too large to make the explosion theory feasible. In Crater Lake, Oregon, fairly small as calderas go, seventeen cubic miles of rock have to be accounted for, and only about ten per cent of this amount of material is spread around the neighboring area. There must be another explanation for the disappearance of the remainder of the mountaintop.

The only other way the top could go is down; that is, the mountain could simply collapse into the earth. But how can an entire mountain collapse? What could it fall into?

The probable cause of the top's disappearance is a collapse facilitated by explosion. The collapse starts as an unusually violent eruption. Great quantities of frothy magma spout from the cone, and terrific explosions scatter white-hot rocks for hundreds of yards. Huge avalanches of fiery lava pour down the valleys, and the sky is black for miles around because of the choking dust. The eruptions become more violent, and perhaps two or three cubic miles of powdery cinders are thrown into the air. For days the explosions continue.

(*Continued on page 34*)



Courtesy of Geological Society of America.

Upper view: A volcanic cone formed by flowing lava and ash deposits. Valleys are due to erosion. Dotted line shows the line of collapse of the top. Lower view: The caldera of the same cone, after top has collapsed. The small island in the lake is a volcanic cone that formed after the collapse.

can gravity be abolished?

Of Course Not, But...

By John C. Cook

From the earliest days to the present, mankind has been wasting enormous amounts of energy to lift things. The coolie has ever struggled up the mountain pass with his cart, fighting the pull of the earth's gravitational attraction at every step, and putting into his load the calories of muscular energy provided by his hard-earned rice. Upon reaching the top and beginning the descent of the other side, he must again fight the force of gravity to prevent this same energy, which he has so laboriously stored in the cart, from carrying it forward at greater and greater speed until his goods are smashed against some rock at a bend in the twisting mountain trail.

This or similar experiences are old and familiar to everyone. But systematic understanding of the nature of force, energy, and weight is new. Only during the past century and a half has knowledge of mechanics and thermodynamics developed to a state where we can appreciate that, in a sense, all the effort of the coolie was wasted. We now can say positively that in terms of energy he has accomplished nothing in crossing the mountain. He has merely pushed against his own future opposition for several miles through the energy-storing property of the earth's gravitational field.

Since the coming of the industrial revolution, this problem of energy waste has become more acute by a thousandfold. Millions of tons of coal have been burned by locomotives dragging freight up mountain slopes, with the net result that thousands of cast-iron brake shoes have been worn out against steel wheels to dispose of this vast energy during the descent. Millions of automobiles burn up precious petroleum climbing hills with similar results. If man is ever to set foot on the other planets, he must lend to the gravitational field of the earth, energy equivalent to at least three tons of hydrocarbon fuel for each ton of rocket ship lifted into interplanetary space. If the interplanetary explorers wish to return (as most explorers do), an equal amount of fuel should be burned to slow the ship's descent as the original energy is repaid by gravity. To the would-be astronaut, gravity is not only a prodigal nuisance but, at present, an insurmountable barrier.

If by some new means a space ship could be made weightless, the laws of mechanics would allow it to travel to the furthest reaches of interplanetary space with no greater expenditure of fuel than enough to overcome inertia and air resistance near the earth. Numerous other practical applications of weightlessness suggest themselves. Man's ancient dream of free flight like the birds might then be fully realized. Stair climbing might become unnecessary. Heavy furniture might be moved with no more than a gentle push from a woman's dainty hand. And, of course, freight handling would be much simplified.

Before launching upon our speculations as to how such a control of gravity might be achieved, it would be well to review what is known about some of the fundamentals of physics involved.

As has already been frequently suggested, what we call the gravitational field has the ability to store up something known as energy when any material object within its domain of influence is lifted. This always requires what physicists formally call "work"; that is, the exertion of force to move the object some distance against restraint. Mechanical work requires an equivalent amount of some kind of fuel to be burned, to provide which requires a certain amount of human effort. If the object is subsequently allowed to fall, the stored gravitational energy is given up, perhaps to be dissipated as sound and heat should the falling body strike the ground. This property of giving up the same energy as was previously stored is expressed by calling the gravitational influence a conservative field of force.

Several other conservative force fields are known, some of which share other properties with gravitation, and so are closely analogous. Very similar to the gravitational attraction of one massive body for another is the attraction of a north magnetic pole for a south magnetic pole, or the affinity of a positive charge of electricity for a negative electric charge. All three types of force diminish as the distance between the corresponding charges (used in a general sense) is increased, and in proportion to the square of the distance. All three act (most mysteriously) across apparently empty space with no discernible means of connection. All are energy-conserving for any motion of one charge from one place to another in the field of influence of the other charge. The energy stored (called "potential" by physicists) depends only upon the relative positions of the charges.

But there are differences as well as analogies. There are two kinds of electric charges and two kinds of magnetic charges (poles). Opposite kinds attract each other, but like kinds repel each other. Only one kind of gravitational charge is known, and in this case like charges always attract each other. Another difference lies in the great disproportion in the size of the effects. A pair of typical fundamental particles of matter, for instance two hydrogen ions, experience a mutual electrical repulsion force 1.23×10^{36} times as great as the gravitational attraction between them. (Magnetic forces are of the same order of magnitude as electrical, but would not be expressible in this way because ions do not have isolated magnetic poles.)

However, the analogy between magnetic, electrical, and gravitational phenomena would be complete if the existence of negative mass were admitted. Two European theoretical physicists, Honl and Papapetrou, have postulated that such negative masses exist within electrons and other fundamental particles of matter. Held together by other powerful forces, the hypothetical negative and positive mass-charges within these subatomic particles would repel each other with enormous force. From other well-known electronic phenomena, the theory predicts a slight excess of positive mass in each particle, just large enough to cause the familiar weak gravitational attraction between all the bodies of matter in the universe, which acting between ourselves and the massive earth is what we know as our weight.

How any of the three force fields operates remains

one of the great mysteries of science. Possibly the mechanism involved, if such a concept applies, is foreign to our understanding. Nevertheless man has recently learned to handle electric and magnetic fields with great facility, to his pleasure and profit. For example, it is possible to erect shields which can by-pass and exclude such fields from a selected region of space. This is done in every radio set. If the gravitational field is fully analogous to electrostatic and magnetostatic fields, such shielding from the pervading gravitational field of the earth should be equally possible.

Let us outline the theory of construction and operation of such a gravitational shield, assuming such analogy and correspondence.

The operation of the known force shields requires the polarization of some special material. For instance, if a metal box is placed in an electrostatic field, the free electric charges in the metal will flow to new positions under the attractive influence of the field. This occurs in such a way that the free negative charges are separated from the positive just enough to create a new electric field within the box which exactly cancels the original field. This is a form of electrical polarization. Magnetic shields also work by means of polarization effects. A room could be shielded from the gravitational field of the earth if some material were available in which an analogous gravitational polarization, or separation of charges (negative and positive masses), could occur.

Suppose, for instance, that some superatom-smasher, an electron-smasher, should chew up the so-called fundamental particles of matter into fragments which we would discover to be very large negative and positive mass particles. These we would collect and pipe to our weightless room. The supernegative particles would be spread under the floor to repel persons of normal (positive) mass walking above. The superpositive particles would be spread over the ceiling to attract normal masses below. The combination would be exactly analogous to an electrical condenser. If the charges were properly adjusted, their gravitational field within the room would just neutralize that of the massive earth.

Such a gravitational shielded room would be a very interesting place in which to live. Objects released from the hand would not fall, but would float about in mid-air, rotating gently with the last impulse imparted to them. One could sleep without a bed, levitated weightless in utmost comfort while sprawling in all three dimensions. Certain delicate scientific experiments with which normal gravity interferes could be performed there.

An important difference would exist between such gravitational shielding and the familiar electrostatic shielding; the gravitational charges would not distribute themselves properly. Under the influence of the earth's field, negative charges would try to rise and positive ones to fall to the bottom of the room, and after doing so, they would increase the field between. The polarization would have to be artificially maintained.

There is also an awkward problem of magnitudes. It can be readily calculated that the negative and positive charges necessary to shield a room from the earth's attraction would each weigh 1.2 million tons per square foot of floor in themselves, and would repel each other with a force of around six hundred thousand tons per square foot, though the combination of both positive and negative gravitational charges held together would weigh little or nothing. To build a structure capable of maintaining our hypothetical shield in place around the room appears rather impractical, even though gravitational charges of enormous effective negative or positive mass, but small size, could be produced by the splitting of subatomic particles, as per Honl and Papapetrou.

Although such gravitationally shielded enclosures would probably prove impractical for most purposes, the isolation of negative masses or their equivalent would be very beneficial to man. If one hundred and forty-nine "effective pounds upward weight" of negative matter could somehow be produced, it might be made into a suit capable of almost lifting a one hundred and fifty pound man. A man so equipped would weigh only one pound. Retaining his normal strength, a man weighing so little would be able to leap to the tops of high buildings and there perform the hazardous work of a rigger with safety and agility. If he should fall, air resistance would slow his fall much as though he were an air-filled rubber beach toy. He would enjoy even greater safety if the negative mass augmented his own inertial mass, rather than cancelling most of it, as assumed above. This would cause him to experience an acceleration of gravity far less than that which jerks other mortals downward so quickly when they trip over a rug. He would have three-quarters of a minute to call for a rope while falling one hundred feet, and failing that, he would land as gently as if from a three-foot kitchen stool without the miraculous suit of clothes.

Whether or not negative gravitational mass would also exhibit negative inertia is a matter for conjecture. It may be that gravitation and inertia arise from mass charges in a manner analogous to the way in which electric and magnetic fields arise from electric charges; the latter effect in each case stores energy when the charge moves. For this and other reasons it seems likely that negative gravitational mass would exhibit the usual (positive) inertia.

Regardless of inertial effects, negative gravitational mass would have many uses. It might be built into heavy tools to render them almost weightless. Airships and spaceships would load sufficient negative weights to nearly compensate for the weight of the ships and loads, much reducing the fuel requirements. In short, all loads could be lightened to a fraction of present values with corresponding savings of valuable fuel and human effort.

No one can say whether negative mass will ever be discovered, either by deeper researches into the realm of subatomic physics, or perhaps by searching for it far out among the distant stars. Certainly, no matter as we know it has the required property of gravitational polarizability. Terrestrial experiments seem to indicate that all familiar matter is fundamentally alike, and that it cannot ever exhibit gravitational repulsion nor be made into gravitational shields. Delicate measurements show that the gravitational attraction of the sun and moon is not at all affected by intervention of the earth's bulk, which consists of eight thousand miles of dense iron and stone.

Another attack on the problem of the eventual control of gravity lies in the study of inertia, time, and space by theoretical physicists. The General Theory of Relativity is an encouraging development. Yet another possibility is experimental study of certain minor gravitational phenomena amenable to laboratory research. Measurements of the velocity and absorption of propagation of oscillating gravitational fields, that is, gravity waves, might prove stimulating to the next generation of theoretical workers in physics. There seems to be adequate reason for hoping that gravitation will some day rank with electricity and magnetism among the servants of the mind of man.

tech engineering news

Professional Journal of the Undergraduates of the
Massachusetts Institute of Technology

Managing Board

KENNETH D. KOPPLE, '51 . . . . . General Manager
GEORGE B. FIELD, '51 . . . . . Editor-in-Chief
WILLIAM R. LUCAS, '51 . . . . . Managing Editor
JERRY B. LEVINE, '51 . . . . . Business Manager

Junior Board

ROBERT DONOVAN, '52 . . . . . Literary Associate
COSTA CHITOURAS, '53 . . . . . Literary Associate
WILL THOMPSON, '53 . . . . . Makeup Editor
CHARLES SALTSMAN, '52 . . . . . Art Editor
HARVEY EISENBERG, '52 . . . . . Circulation Manager
BERNARD GORDON, '52 . . . . . Treasurer
ANTHONY RANTI, '53 . . . . . Advertising Manager
WERNER KAHN, '52 . . . . . Office Manager

Staff

DAN BRZEZENSKI, '53
LARRY ISAACSON, '53
JOHN MATHIS, '53
SHERWIN KALT, '53
JAN PIOTR KOWALSKI, '52
ROBERT REDICK, '53
BARRY STEIN, '53
HOWARD DAVIS, '53
DAVID IOLA, '53

Sales Staff

HOWARD BERNSTEIN, '51
RICHARD CIESLUKIEWICZ, '53
RICHARD PAGANI, '53

Publisher's Representative

LITTELL MURRAY BARNHILL, INC.
101 Park Avenue, New York
605 North Michigan Avenue, Chicago

from the editor's notebook

Don't Buck It, Use It...

Is it fair to say that the only way to get a job for the summer is to be Somebody, or at least know somebody? I feel this way about it: it seems that unless the student is in a field where jobs for inexperienced men are found, the dictum "it takes experience to get experience" comes into play. Floored by this paradox, the hapless jobhunter looks high and low for anything at all. That is, unless he has "pull." The way out of this, I think, is not to think bitterly of the fellow who *did* get the job, but to realize that friendship is actually a good recommendation. The friend is known to be O.K.; the fellow who just comes in and asks for a job is questionable. We students have thousands of potential friends all over the country in responsible positions — the alumni of M. I. T. However, they are only potential. There must be some further recommendation than a common alma mater. But such a recommendation will at least eliminate the automatic cold shoulder prevailing today, and open the door to a really personal interview. Perhaps a system could be evolved giving us lists of alumni in each city, and the alumni lists of fellows they may expect to see.

The Editor Speaks...

We of the *T. E. N.* staff have a vague feeling that we want to put out a good magazine. This feeling is always common among new staffs. Whatever its origin, my personal view is just this: a good magazine is one which awakens rather than lethargizes. To do this we must have one thing — newness. New viewpoints, new facts, new modes of expression, with complete repugnance for ideas and tendencies which are already common in M. I. T. life. Such innovation is obviously not generally heard around Tech. The reason, perhaps, is that new ideas are pretty much the product of individuals and are apt to stay with them unless dug out by some sort of thought monger. Well, maybe you've guessed by now, our object is to dig out. We solicit original material from all quarters. There is one restriction on the range of subjects treated; they should be meaningful to the students. Such a range, bounded by the intellectual propensities and social and personal needs of the students, will be hard to define. The point is that we intend to experiment reasonably.

G. B. F.

Those Who Came Through...

Andy Price, who graduated last year from Course XIV-C, was familiar to all as General Manager of *Voo Doo*. Holding a seat on Inscom, he became interested in activities, interested enough, in fact, to study them scientifically and do a thesis on them. Our offering is Andy's attempt to bring the facts to light in a short article. Andy now works for Sylvania Electric. **Charlie Saltsman** has always been a hand at sailing and writing about it. This time he talks about another interest, which perfectly unites the artist and the engineer. **Art Wasserman** uses his little-publicized talent in music to again think seriously about making art practical.

John Mathis was a newcomer to volcanoes, as were we. Do you agree that the meeting was a happy one for all?

John C. Cook is a student at Penn State. His article took second prize in an essay contest sponsored by Roger Babson's Gravity Research Foundation. We think that he has successfully explored the pertinent possibilities, such as they are. We are eager to say that this exploration gave him a net profit of $300. Other prizes — first, $1,000; third, $200; fourth, $150.

It seems that with the story of N. S. F. we are becoming advocates of an "Open Palm Policy," but to correct this appearance, let it be known that the last date for essay receiving was October 1!

Only STEEL can do so many jobs

CLEANER THAN YOUR BEST CHINA. The inside of a food can is "surgically clean." Sterilized in processing, it is cleaner *and* safer than any dish. The Department of Agriculture reports, "It is just as safe to keep canned food in the can—if the can is kept cool—as it is to empty the food into another container." And, incidentally, did you know that "tin cans" are really about 99% *steel?*

HOW TO LIFT A MILLION POUNDS. This crane runway, whose structural steel was fabricated and erected by United States Steel for the San Francisco Naval Shipyard, is 730 feet long, 209 feet high, extends 162½ feet over the water at each side. It can lift gun turrets and other huge sections weighing as much as 1,000,000 pounds.

THE SOFTEST THING YOU CAN SLEEP ON IS STEEL. For solid comfort, you can't beat mattresses that have inner springs of steel. Especially if the inner springs are made of U·S·S Premier Spring Wire, specially developed by United States Steel to give lasting resiliency and buoyancy to the inner springs of sleep equipment and upholstered furniture.

AMERICAN BRIDGE COMPANY • AMERICAN STEEL & WIRE COMPANY • CARNEGIE-ILLINOIS STEEL CORPORATION • COLUMBIA STEEL COMPANY • H. C. FRICK COKE AND ASSOCIATED COMPANIES
OLIVER IRON MINING COMPANY • PITTSBURGH LIMESTONE CORPORATION • PITTSBURGH STEAMSHIP COMPANY
UNITED STATES STEEL PRODUCTS COMPANY • UNITED STATES STEEL SUPPLY COMPANY

so well...

NEW ICE CREAM IDEA. In certain parts of the country, you can now buy individually packaged single servings of ice cream. They're called "Diced Cream"... and they strike a new high in sanitation, economy and convenience. Diced Cream is made in machines fabricated largely from stainless steel—to assure maximum purity in the finished product.

STAINLESS STEEL GOES TO SCHOOL. What a change from the little red schoolhouse! This new school in California embodies the latest features in school construction, including the use of U·S·S Stainless Steel for architectural trim. The stainless trim resists atmospheric corrosion, harmonizes with the building design. United States Steel produces steel of all kinds for such buildings . . . continuing its number-one job of helping to build a better America.

Listen to... The Theatre Guild on the Air, presented every Sunday evening by United States Steel. National Broadcasting Company, coast-to-coast network. Consult your newspaper for time and station.

MANUFACTURED FROM USS STEEL UNITED STATES STEEL

...and this label is your guide to quality steel

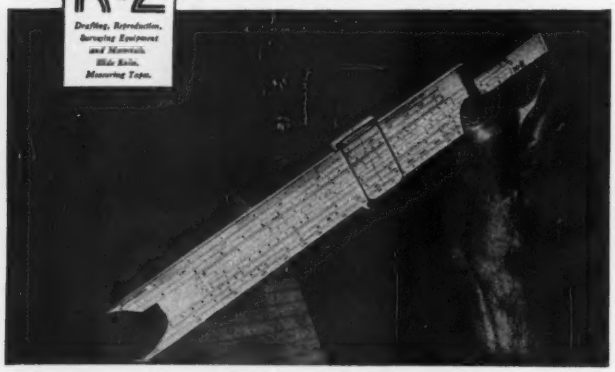
UNITED STATES STEEL

Helping to Build a Better America

GENEVA STEEL COMPANY • GERRARD STEEL STRAPPING COMPANY • MICHIGAN LIMESTONE & CHEMICAL COMPANY • NATIONAL TUBE COMPANY • OIL WELL SUPPLY COMPANY
TENNESSEE COAL, IRON & RAILROAD COMPANY • UNITED STATES STEEL EXPORT COMPANY
UNIVERSAL ATLAS CEMENT COMPANY • VIRGINIA BRIDGE COMPANY

partners in creating

Engineering leaders for the last 81 years have made K & E instruments, drafting equipment and materials their partners in creating the great technical achievements of America. So nearly universal is the reliance on K & E products, it is self-evident that every major engineering project has been completed with the help of K & E.

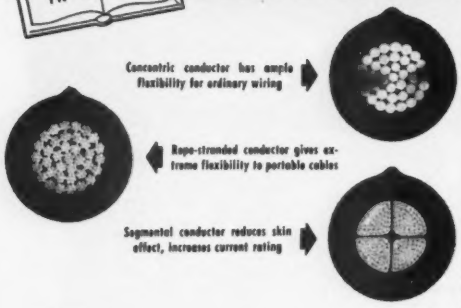


KEUFFEL & ESSER CO.

EST. 1867

NEW YORK • HOBOKEN, N. J.
Chicago • St. Louis • Detroit
San Francisco • Los Angeles • Montreal

PERFECTLY-CENTERED CONDUCTORS


Concentric conductor has ample flexibility for ordinary wiring
Rope-stranded conductor gives extreme flexibility to portable cables
Segmental conductor reduces skin effect, increases current rating

Uneven walls of insulation are a potential source of cable failure. Perfect centering of the conductor, however, is automatically provided by Okonite's Strip Insulating Process in which continuous rubber strips of *uniform thickness* are folded about conductor. Only by this method can insulation wall be gauged, inspected *before application.*

Uniform walls of insulation are assured when you specify Okonite wires and cables. The Okonite Company, Passaic, New Jersey.

6012

OKONITE SINCE 1878

insulated wires and cables

what's wrong with activities?

(*Continued from page 9*)

Class *B*'s clamor for Class *A* status. The Class status is becoming a joke as a result of the lack of clear requirements. Also the Class *A*'s are controlling the student government. The more Class *A*'s get into power, the more pressing becomes the prestige problem of the remaining Class *B*'s. So more Class *B*'s request *A* status, and around the circle we go.

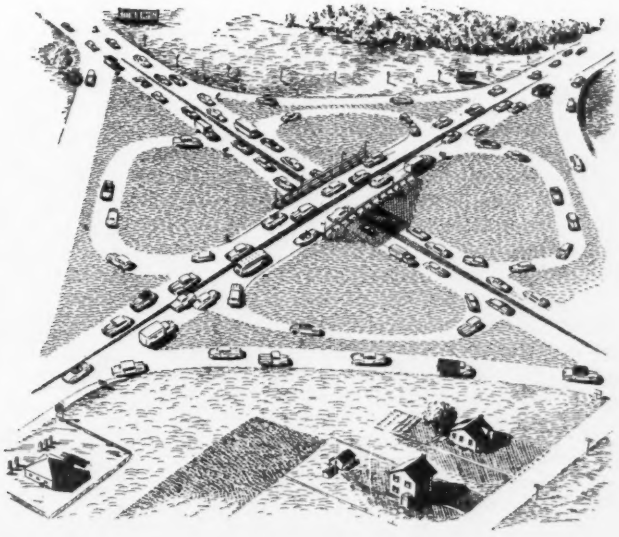
My suggestion for improving this situation is to reorganize our whole student government setup. I would have the governing body composed of a majority of class-elected members and a minority selected by all the activities. Eliminate entirely the class status of activities and have the activities grouped into like interests with one Inscom representative from each group. Such an arrangement is exemplified by the Combined Professional Societies, and the Combined Musical Clubs. Instead of four Class *A* publications and three Class *B*'s, have a publication group of all seven and one man to represent the group in the student government. I see no difficulty in grouping the activities, though some minor troubles may come up. Such a solution would result in all activities having a voice in their control, and through the groupings all activities would have a channel of communication with the government.

In this plan, the heads of the government committees would not have a seat on Inscom. The Cabinet of the United States is not represented in the lawmaking bodies, and as the executive agents of the student government there is no valid reason why the chairmen be ex-officio members and officers of Inscom. As for subcommittees, I believe it is perfectly feasible to have the elected members of Inscom handle the coordination of the committee and the government while getting its membership from the student body. That is a system similar to that of Congress, where the lawmakers are on subcommittees, but due to the small size of Inscom, the subcommittee membership could not easily come from the committee.

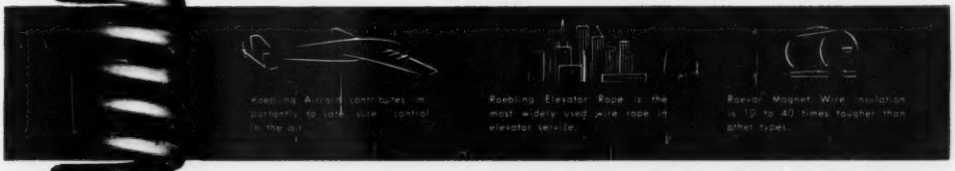
The elected Inscom membership would consist of the President, Vice-President and two representatives from each class. The reason for including the Vice-President is to create more value for the position and thus increase interest and participation in class elections. Including the Vice-President would in addition prevent any living group from dominating the committee.

I believe the acceptance of this plan would eliminate the pyramiding of responsibility, the squabbling over class status, and the limitation of prestige to a few activities. It would put government back in the hands of the students, open up better channels of communication, and spread responsibility among more individuals.

I do not claim that this plan would solve the extra-curricular participation problem, but I do most emphatically believe that an examination of our present activity and government setup can bring to light ways to provide the would-be activity man with concrete goals.



The forgotten half billion


Roebling Aircraft contributes importantly to safe, sure control in the air.
Roebling Elevator Rope is the most widely used wire rope in elevator service.
Roevar Magnet Wire insulation is 10 to 40 times tougher than other types.

IT'S EASY to forget a product that gives almost flawless performance. Most people, for instance, never think of the valve springs in their cars... largely because wire developments have brought them to a point approaching metallurgical and mechanical perfection. The half billion valve springs in service today... closing each valve as often as 12 times a second, from sub-zero temperatures to 400°F... will prove almost 100 per cent dependable for years on end. Roebling is a chief supplier of round spring wire to valve spring manufacturers.

Today, too, Roebling's wide line of wires and wire products offer economies to *every* field of industry. A full range of high carbon specialty wires... wire rope for every sort of rope-rigged equipment... more than 60 types of electrical wire and cable... a complete range of woven wire screens. Write for information about the Roebling products of interest to you.

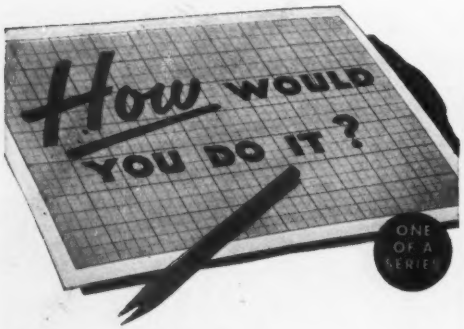
EXTRA QUALITY...
EXTRA VALUE... THAT'S WHY

Today it's Roebling!

JOHN A. ROEBLING'S SONS COMPANY, TRENTON 2, NEW JERSEY

Atlanta, 934 Avon Ave. ★ *Boston*, 51 Sleeper St. ★ *Chicago*, 5525 W. Roosevelt Road ★ *Cincinnati*, 3253 Fredonia Ave. ★ *Cleveland*, 701 St. Clair Ave., N. E. ★ *Denver*, 4801 Jackson St. ★ *Houston*, 6216 Navigation Blvd. ★ *Los Angeles*, 216 So. Alameda St. ★ *New York*, 19 Rector St. ★ *Philadelphia*, 12 So. Twelfth St. ★ *San Francisco*, 1740 Seventeenth St. ★ *Seattle*, 900 First Ave. So.

A CENTURY OF CONFIDENCE



PROBLEM—You are designing a telescoping radio antenna for automobiles. You want to provide a means for extending and retracting the antenna sections from a convenient point inside the car. How would you do it?

THE SIMPLE ANSWER—The illustrations show how one manufacturer did it—with two S.S.WHITE FLEXIBLE SHAFTS. One shaft, operated from the control knob, turns a reel at the base of the antenna. The other, on the reel, pushes up and pulls down the antenna sections as the reel is turned. As S.S.WHITE shafts can be supplied in any length, this arrangement makes the antenna adaptable to all types of cars and other motor control shaft vehicles.

Photos courtesy of L. S. Brach Mfg. Corp., Newark, N. J.

This is just one of hundreds of power drive and remote control problems to which S.S.WHITE FLEXIBLE SHAFTS are the simple answer. All engineers will find it helpful to be familiar with the range and scope of these "METAL MUSCLES"* for mechanical bodies.

*Trade Mark Reg. U.S. Pat. Off. and elsewhere

SEND FOR BULLETIN 4501

It gives basic information and engineering data about flexible shafts and their many uses. We'll gladly send you a free copy on request.

S.S.WHITE INDUSTRIAL DIVISION

THE S. S. WHITE DENTAL MFG. CO. — DEPT. C, 10 EAST 40th ST., NEW YORK 16, N. Y.

FLEXIBLE SHAFTS • FLEXIBLE SHAFT TOOLS • AIRCRAFT ACCESSORIES
DENTAL CUTTING AND GRINDING TOOLS • SPECIAL FORMULA RUBBERS
MOLDED SPECIALTIES • PLASTIC SPECIALTIES • CONTRACT PLASTICS MOLDING

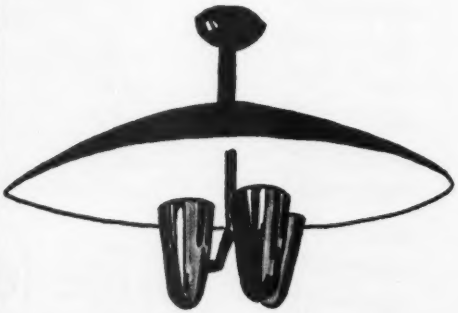
One of America's AAAA Industrial Enterprises

order out of chaos

(*Continued from page 11*)

sudden vertical hunk of perforated chrome just in front of the rear wheel. Because of this one line, which shackles the car to the parking lot, the entire design is destroyed. A design cannot be only half right.

Looking around the house, one finds many examples of the Industrial Designer's work. Take, for example, the bathroom sink by Henry Dreyfuss. The shape of the bowl is not merely an arbitrary geometrical one which Mr. Dreyfuss thought would look attractive: it was determined by observing how a person's hands and arms move when washing. The form thus described turns out to be pleasing, an example of the theory that good design follows mechanical, or functional, perfection.

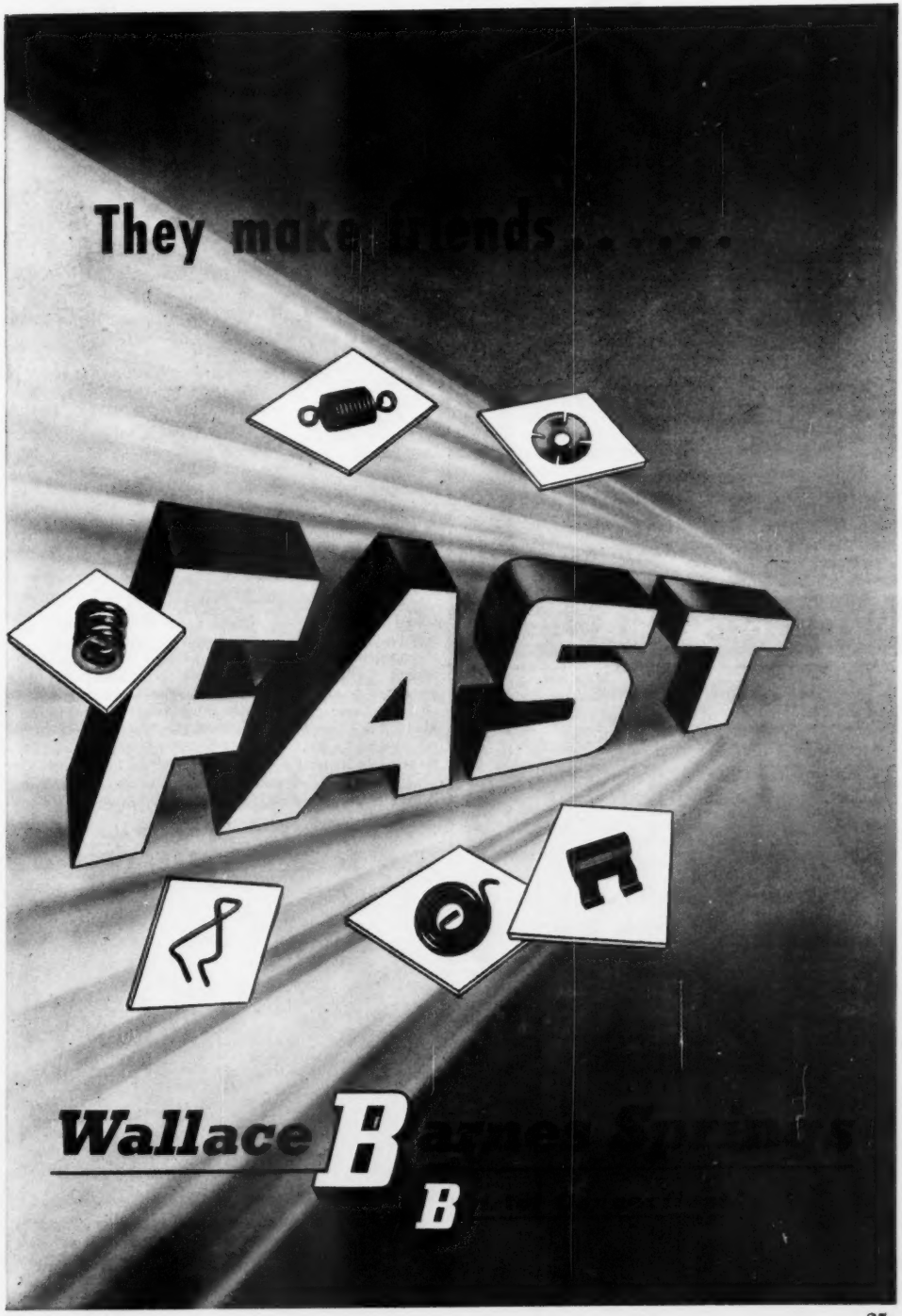


A modern lamp. Good design = simplicity + sales + lots of light.

The staircase illustrated is a good example of the ease and simplicity with which a thing can be accomplished. Ours is an age of simplicity in material things, and this is reflected in the homes we live in, the furniture we buy, the clothes we wear, and the things we like. The modern stairway is a far cry from the ornately banistered one of a half century ago. The reason for this is not entirely one of taste, or good design, but of necessity as well. Man no longer has time to carve risers and turn posts as he did a few generations ago, nor has he much inclination to use his valuable minutes in dusting such intricate woodwork. Industrial Design, which brings this simplicity to us, does not always work toward pleasing shapes and patterns, for its products are often those of sheer necessity.

Consider for a moment the illustration of the IBM computing machine, another of the many achievements of the Industrial Designer. Not only does this machine give excellent service, but it has beauty as well—beauty of simplicity, of shape, and of dignity. When the designer first took on the job of making more attractive machinery, and this includes lathes and typewriters as well as computing machines, he proceeded a little cautiously, for the possibility that products from a factory containing good looking lathes would sell any better, or that figures from a handsome computing machine be any more accurate seemed remote. Yet, since then it has been found that machinists do better work and more work on a well-designed lathe than on an older, poorer looking one. And businessmen have

(*Continued on page 26*)


They make friends . . . . .
FAST
Wallace Barnes Springs

MILLING CUTTERS
— many styles and sizes

Efficient milling on a wide variety of work and materials is made possible by the broad range of styles and sizes offered in this complete line of cutters. Brown & Sharpe Mfg. Co., Providence 1, Rhode Island.

BROWN & SHARPE BS

Quick-freezing Corn-on-the-Cob with Frick Refrigeration

The Frick-Freezer Operates at 30 Deg. Below Zero

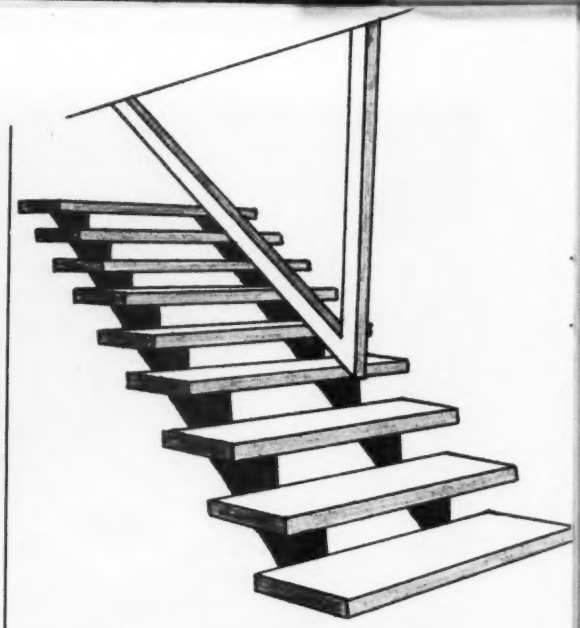
The W. E. Bittinger Co. freezes cut sweet corn and corn-on-the-cob, as well as spinach, at its new plant in Hanover, Penna. Its Frick-Freezer handles 30,000 pounds of corn a day; its storages hold 400,000 pounds.

Another example of the effectiveness of Frick low-temperature refrigeration — used also in the world's largest quick-freezing plant.

The Frick Graduate Training Course in Refrigeration and Air Conditioning, operated over 30 years, offers a career in a growing industry.

Four Frick Compressors at Hanover

FRICK CO.
WAYNESBORO PENNA. U.S.A.
Also Builders of Power Farming and Sawmill Machinery



A modern staircase. Simplicity is the keynote.

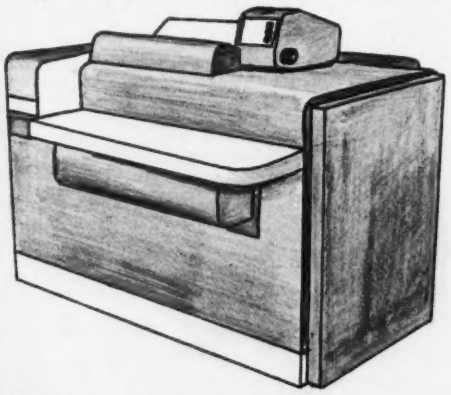
order out of chaos

(*Continued from page 24*)

found that their secretaries have little difficulty in handling a complicated computer when the maze of mechanical parts are disguised under a good looking design. The machine looks less formidable, and the secretary learns to operate it as she would a kitchen stove. There can be little doubt that such achievements are of great value to modern society, and such achievements are made only through such a driving force as Industrial Design.

From this brief, and far from complete, discussion, it may readily be seen that the whole subject of Industrial Design is complicated and far-reaching. Yet it is of such great importance today that it should be more familiar to everyone. Scarcely a quarter of a century old, it has already expanded in such a way that it

(*Continued on page 34*)



IBM Machine. Like a kitchen stove.

BOTTLENECKS

Have No Place in Production—or in Your Future Progress!

by CHESTER E. MEYER
Superintendent, Production Scheduling
General Machinery Division
ALLIS-CHALMERS MANUFACTURING COMPANY
(Graduate Training Course 1938)

PRODUCTION CONTROL in a big plant like the Allis-Chalmers West Allis Works is a constant campaign to prevent bottlenecks and keep orders moving along smoothly to meet scheduled shipping dates.

CHESTER E. MEYER

Most men face much the same kind of personal problem when they get out of engineering school and plan a program of graduate training and experience leading to a firm position in the work they want to do. They can't afford to risk bottlenecks and blind alleys in that program, either.

Big Opportunity

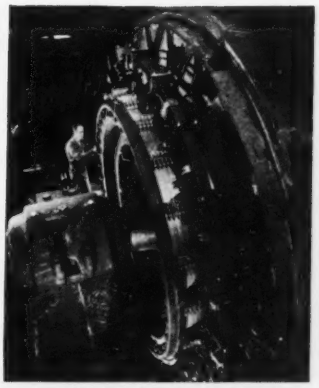
I had this in mind when I graduated from MIT in 1936 and enrolled in the Allis-Chalmers Graduate Training Course. I'd been particularly interested in production and sales. I was looking for practical training, experience and opportunity. And I got them.

First assignment was in Steam Turbine erection. Then I went to the Centrifugal Pump Department, and worked on cost analysis. This job gave me a chance to study plant layout and manufacturing methods, and put me in contact with the Time Study and Planning Department. I liked the work, and finished up the course in that department. I've stayed in the same type of work ever since.

Here in Production Scheduling we pick up each job after the Planning Department has established the routing. It's up to us to set a shipping date, and then work out dates when the job is to be completed in the various shops through which it must go. This requires a thorough knowledge of methods, shop capacities and work loads throughout the entire plant.

Great Diversity of Products

To give some idea of the extent of this operation, here are a few facts about the West Allis Works: The floor area of the buildings is more than 160 acres. There are 14 miles of railway and 4 miles of roads within the plant, and the shops contain more than 30,000 power tools, from small precision machines to the great 40-foot boring mill. It requires 208 traveling cranes to handle materials and equipment. There are twelve great machine, assembly and erection shops, three foundries, pattern shop, tank and plate shop, forge shop, mill shop and many miscellaneous buildings used in manufacturing.



Assembling big direct-current blooming mill motor for test—last step in the manufacturing process before shipment and final installation.

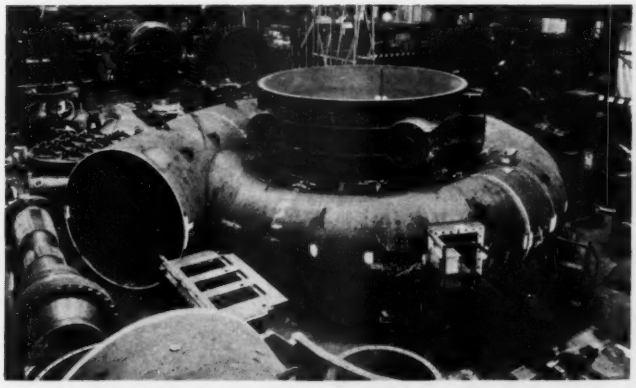
Some of the big jobs going through now include a 107,000 kw steam turbine unit for a midwest utility and two complete new hydraulic turbine and generator units for Hoover Dam. There's an order for six 22,000 hp pumping motors for a West Coast irrigation project, and another for one of the largest power transformers ever built. Rotary kilns up to 400 ft. in length, gyratory crushers weighing 500 tons and 22 million volt Betatrons are all products of these shops. So are delicate electronic and control devices.

Allis-Chalmers designs and builds basic machines for every major industry: steam and hydraulic turbine generators, transformers and other equipment for the electric power industries; crushers, grinding mills, rotary kilns, screens and other machines for mining, ore processing, cement and rock products; flour mills and oil extraction plants; electronic equipment; big pumps, motors, drives . . . to name just a few.

Widest Choice

As you can see, Graduate Training Course engineers at A-C can move in just about any direction they choose—any industry, any type of work from machine design, research and product engineering to manufacturing, selling and installation.

The course is set up to allow students plenty of chance to gain training and experience in the work they choose. There's no reason to run into bottlenecks or dead-end streets—for students help plan their own courses, and are free to change their plans as new interests, new opportunities, present themselves.



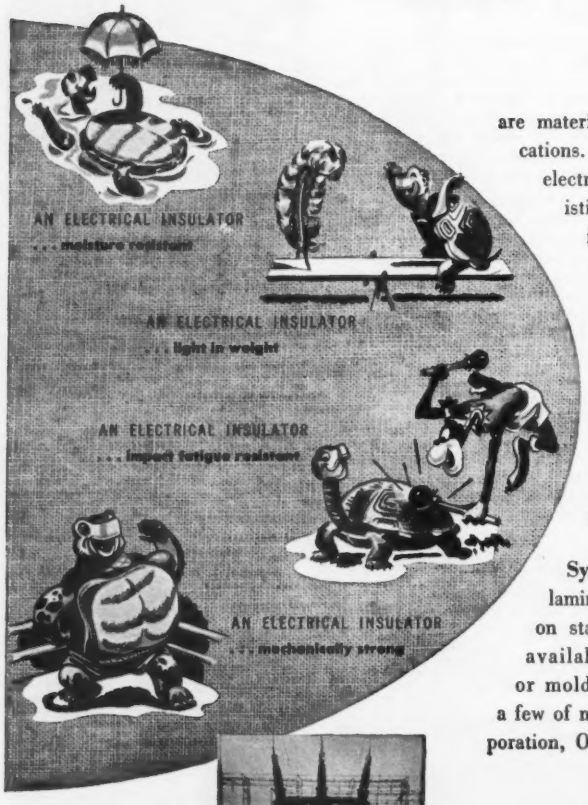
Completed parts flow on a planned master schedule from all parts of the great West Allis Works as this large turbine unit takes form. This is a general view of a part of the vast erection shop.

ALLIS-CHALMERS

Allis-Chalmers Manufacturing Company, Milwaukee 1, Wisconsin

It's an electrical Insulator

It's a new idea Stimulator


AN ELECTRICAL INSULATOR
. . . moisture resistant
AN ELECTRICAL INSULATOR
. . . light in weight
AN ELECTRICAL INSULATOR
. . . impact fatigue resistant
AN ELECTRICAL INSULATOR
. . . mechanically strong

SYNTHANE **Plastic Laminates** are materials expressly made for industrial applications. They have an interesting *combination* of electrical, mechanical and chemical characteristics. This combination often stimulates new ideas in design or use, may improve a product or process or reduce fabrication or maintenance costs.

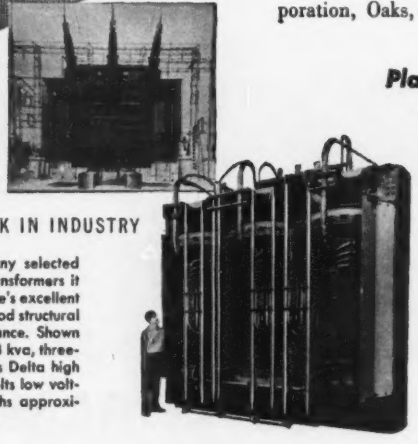
Synthane is an excellent electrical insulator. Synthane is high in dielectric strength, low in dielectric constant and power factor. It is also light in weight, hard, dense, strong, resistant to abrasion, corrosion and moisture, and is dimensionally stable.

Synthane speeds fabrication. Synthane laminated can be machined quickly and easily on standard production equipment. It is also available in a variety of molded-laminated or molded-macerated shapes. These are only a few of many Synthane advantages. Synthane Corporation, Oaks, Pennsylvania.

Plastics where plastics belong

SYNTHANE

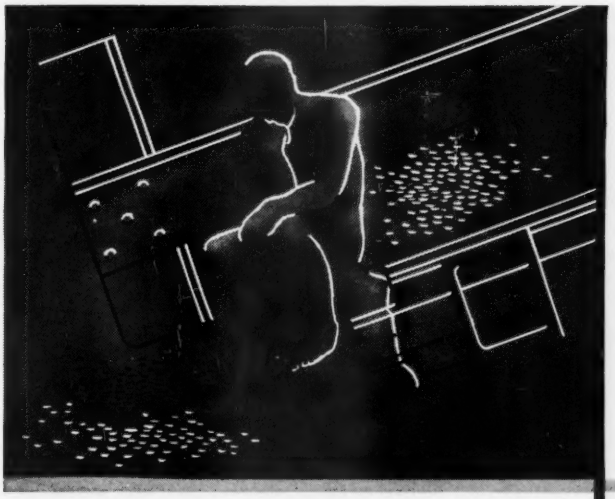
where Synthane belongs



SYNTHANE AT WORK IN INDUSTRY

The Moloney Electric Company selected Synthane for parts of the transformers it produces, because of Synthane's excellent electrical insulating ability, good structural strength and corrosion resistance. Shown at right is the Moloney 33,333 kva, three-phase, 60 cycle 132000 volts Delta high voltage to 34500Y/19920 volts low voltage. The complete unit weighs approximately 227,000 pounds.

DESIGN • MATERIALS • FABRICATION • SHEETS • RODS • TUBES • MOLDED-MACERATED • MOLDED-LAMINATED



Thinking of improving

"Improving" any machine really means increasing its productive capacity. That means tinkering with speeds and weights and strength—ending up with alloy steels.

Which alloy steel?—the one that meets physical requirements at the lowest cost. Molybdenum steels fill that bill. Good hardenability, plus freedom from temper brittleness, plus reasonable price enable them to do it.

Send for our comprehensive 400-page book, free; "MOLYBDENUM: STEELS, IRONS, ALLOYS."

CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS

Climax Molybdenum Company
500 Fifth Avenue · New York City

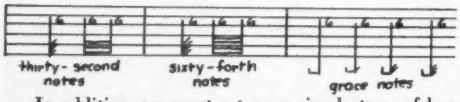
MOLY

C2

Figure 1

system of music notation

(*Continued from page 12*)



In addition, we must set up a simple type of key signature which will still give us the necessary information. A very satisfactory one would be the placing of a small oval on the line (or in the space) representing the note whose major or minor scale is the key in which a particular piece of music is written. A capital or a small "M" placed below the staff might indicate whether it is major or minor, respectively.

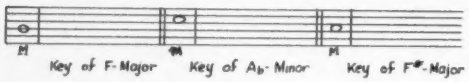
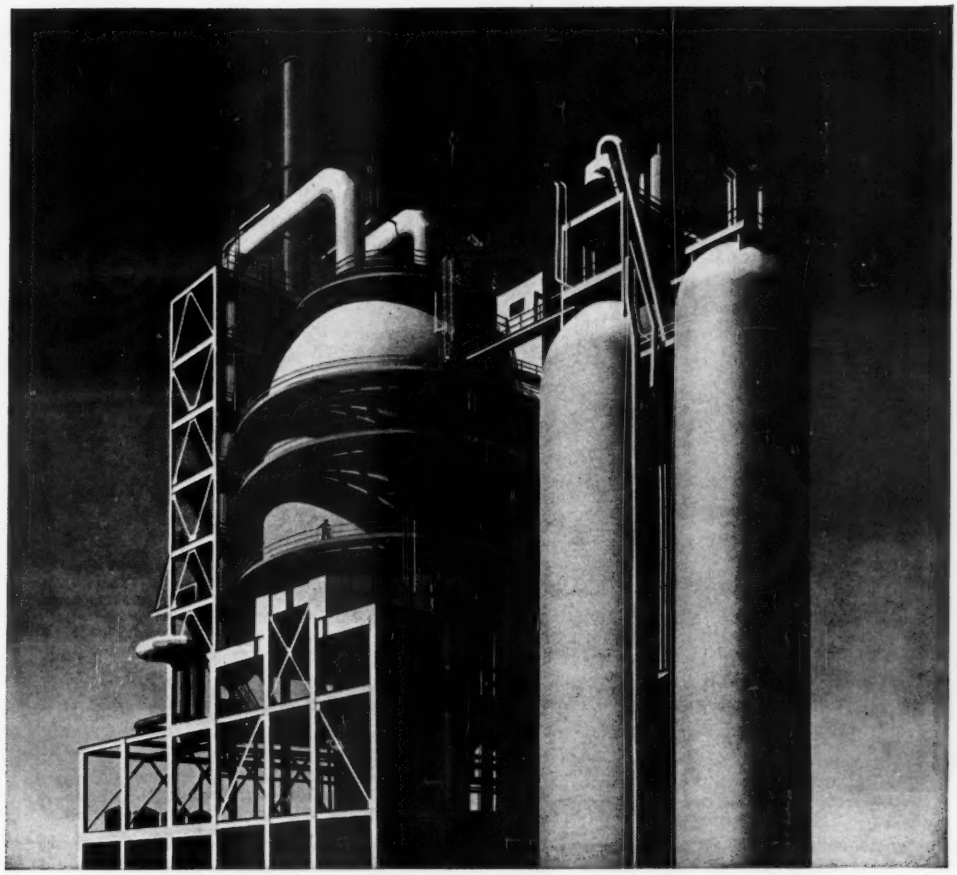


Figure 2

At this point, let us stop and check our progress to see how much we have accomplished of what we set out to do. The three major faults with the present system which we were going to try to correct, you remember, were the use of complex key signatures, ledger lines, and accidentals. We eliminated the need for accidentals by revising our staff such that each line or space, instead of representing one of the eight degrees of the C-major scale, represented one of the thirteen degrees of the chromatic scale. To accomplish this, we used a six line staff which gave us thirteen possible positions in which to place notes. By replacing the heads of the notes with octave numbers to indicate the relative position of the notes in the audible range of tones, we made unnecessary the use of both ledger lines and clefs, since it is now possible to represent all the notes of the audible range on one staff. Apparently, then, we have accomplished what we set out to do.

In Figure 1 I have copied a few bars of music from Malotte's, "The Lord's Prayer," which illustrate, to some extent, the complexity of the standard system of notation. In Figure 2, I have rewritten the same passage using the improved system of notation which we have just devised. Notice the simplified key signature and the elimination of accidentals, ledger lines, and clef signs.

While the improved system, itself, is still far from perfect, it does indicate that the present system is capable of vast improvement. We have not, here, considered the problem of ease of learning of the systems of music notation. I believe, however, that the beginner in the study of music would have no more difficulty learning the improved system than the present system, but that the old student of the standard system would experience some difficulty in changing over.



What's behind the world's champ "Cat Cracker"?

In October, 1949, this world's biggest catalytic cracking plant was put into operation at Linden, N. J., refining oil products for Esso Standard Oil Company.

This behemoth can produce 1,520,000 gallons of liquid power *every day*... that means more heat for homes, more fuel to operate factories and farms, more power to make the nation's wheels go 'round... better living for everybody.

It took a vast amount of scientific skill and achievement, of vision and daring, to build this huge processing plant and put it into operation. Scientific petroleum research and oil engineering progress have always been pioneered and encouraged at Esso.

With the chance to learn and advance on the job, along with fair pay and good working experience... the employees of Esso Standard Oil form a loyal and experienced team, that is constantly striving to improve the high quality and value of products that are sold at the famous Esso Sign from Maine to Louisiana.

Esso

ESSO STANDARD OIL COMPANY

Strength factors of Long Life!

No pipe that is provably deficient in any of these strength factors should ever be laid in city streets

CRUSHING STRENGTH — The ability of cast iron pipe to withstand external loads imposed by heavy fill and unusual traffic loads is proved by the Ring Compression Test. Standard 6-inch cast iron pipe withstands a crushing weight of more than 14,000 lbs. per foot.

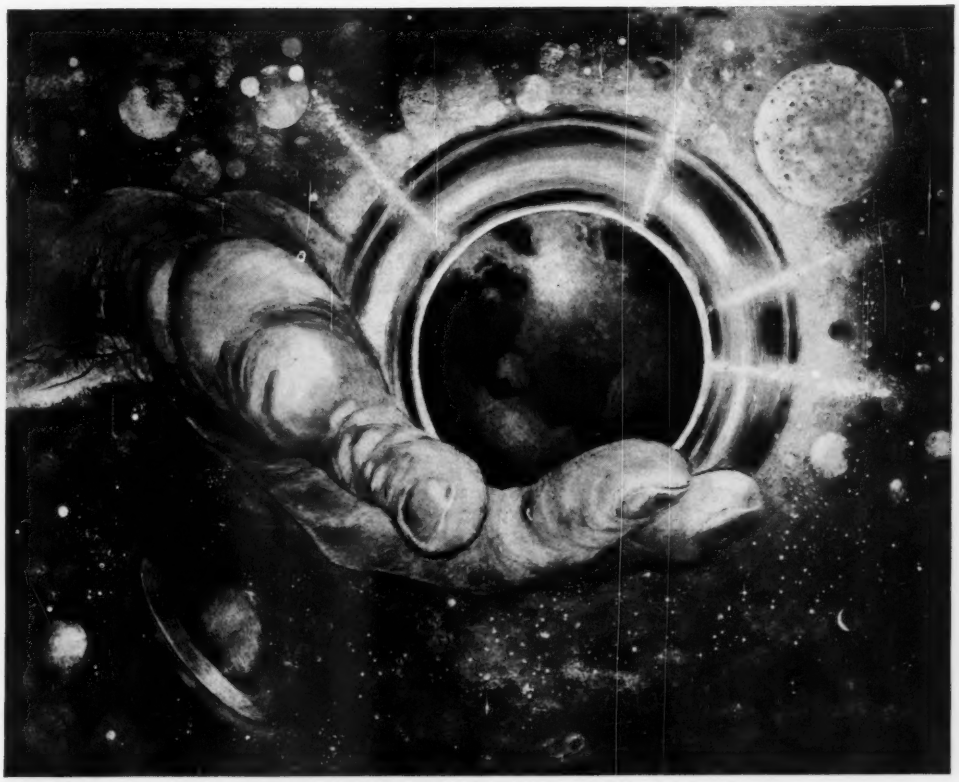
BEAM STRENGTH — When cast iron pipe is subjected to beam stress caused by soil settlement, or disturbance of soil by other utilities, or resting on an obstruction, tests prove that standard 6-inch cast iron pipe in 10-foot span sustains a load of 15,000 lbs.

SHOCK STRENGTH — The toughness of cast iron pipe which enables it to withstand impact and traffic shocks, as well as the hazards in handling, is demonstrated by the Impact Test. While under hydrostatic pressure and the heavy blows from a 50 pound hammer, standard 6-inch cast iron pipe does not crack until the hammer is dropped 6 times *on the same spot* from progressively increased heights of 6 inches.

BURSTING STRENGTH — In full length bursting tests standard 6-inch cast iron pipe withstands more than 2500 lbs. per square inch internal hydrostatic pressure, which proves ample ability to resist water-hammer or unusual working pressures.

Without crushing strength—or, for that matter—without all of the strength factors listed opposite—no pipe laid 100 years ago in *city streets* would be in service today. But, in spite of the evolution of traffic from horse-drawn vehicles to heavy trucks and buses—and today's vast complexity of subway and underground utility services—cast iron gas and water mains, laid over a century ago, are serving in the streets of more than 30 cities in the United States and Canada. Such service records prove that cast iron pipe combines all the strength factors of long life with ample margins of safety. No pipe that is provably deficient in any of these strength factors should ever be laid in city streets. Cast Iron Pipe Research Association, Thos. F. Wolfe, Engineer, 122 So. Michigan Ave., Chicago 3.

CAST IRON PIPE SERVES FOR CENTURIES



Bright New World

FROM MORNING TILL NIGHT, the colors of the rainbow are all around you—through plastics. A blue plastic clock wakes you, and you flip on an ivory plastic light switch. You take your clothes from a yellow plastic hanger. Plastic toothbrushes come in colors for every member of the family. Cheerful decorating schemes are enhanced by the beauty of plastic drapes. There's no limit to the colors you can get in these versatile materials!

But this is only the start of the plastic story. Plastics help make better clothing. Modern furniture and furnishings owe much to plastics. Much of your food is packaged in clean, clear plastics. Plastics add safety, durability, and appearance to many of your electrical appliances.

These versatile basic materials are man-made. Organic chemicals are the ingredients of the "unfinished" plastics—called resins. From these resins come the many different forms of plastics we know.

The people of Union Carbide are leaders in the production of plastics, resins, and related chemicals. They also provide hundreds of other materials for the use of science and industry.

FREE: *If you would like to know more about many of the things you use every day, send for the illustrated booklet "Products and Processes." It tells how science and industry use UCC's Alloys, Chemicals, Carbons, Gases, and Plastics. Write for free booklet C.*

UNION CARBIDE
AND CARBON CORPORATION
30 EAST 42ND STREET UCC NEW YORK 17, N. Y.

Trade-marked Products of Divisions and Units include

BAKELITE, KRENE, and VINYLITE Plastics • LINDE Oxygen • PREST-O-LITE Acetylene • PYROFAX Gas
NATIONAL Carbons • EVEREADY Flashlights and Batteries • ACHESON Electrodes • PRESTONE and TREK Anti-Freezes
ELECTROMET Alloys and Metals • HAYNES STELLITE Alloys • SYNTHETIC ORGANIC CHEMICALS

8 REASONS WHY SKF IS PREFERRED BY ALL INDUSTRY
INTEGRITY
CRAFTSMANSHIP
METALLURGY
TOLERANCE CONTROL
SURFACE FINISH
PRODUCT UNIFORMITY
ENGINEERING SERVICE
FIELD SERVICE
SKF. Bearings are an integral part of complex machines. In many instances, SKF metallurgical skill resulted in the perfection of bearings with special ability to withstand tremendous stresses and strains . . . bearings which permitted the development of rolling mills, presses and the like that mean better steels more economically produced SKF serves all industry . . . everywhere.
SKF INDUSTRIES, INC., PHILA. 32, PA. 7063
SKF
BALL AND ROLLER BEARINGS

the earth's safety valves

(*Continued from page 15*)

The rising gases carry so much of the magma up with them that the liquid level in the central pipe starts to fall. The shocks also open great cracks far below the surface, and the remaining magma flows into them. The storage chamber of magma beneath the peak is rapidly drained. At this stage the violence of the eruption is at a climax.

Suddenly there is an inconceivable shock, and the entire top of the cone falls into the now-drained magma chamber. The noise of several cubic miles of rock falling into the chamber can be heard for thousands of miles. If the cone is in the ocean, the huge wave resulting from the collapse can travel around the world. The famous "explosion" of the island of Krakatoa in the Dutch East Indies in 1886 was just such a collapse, and is said to have produced the loudest sound ever heard by man; the noise was audible in India, two thousand miles away. The dust thrown up by the collapse caused brilliant sunsets throughout the world for several years. Just such an upheaval must have occurred in Oregon centuries ago.

Even after a collapse, the magma below the filled-in chamber often has enough pressure to force up one or more smaller pipes, and eventually an inner cone is built up within the large caldera. Wizard Island is such a cone in Crater Lake, and Krakatoa now has formed a small island. Occasionally the smaller cone becomes large enough to go through the same collapse cycle, and a caldera is formed within a caldera. In fact, the present active cone in Mount Vesuvius, Italy, is the fourth such cone within a cone, or actually a cone within a caldera within a caldera within a caldera!

Although volcanoes can spread much destruction, they do provide much information about the interior of our world. Above all, they remind us of the great energy available in nature that is awaiting harnessing.

the new national science foundation

(*Continued from page 13*)

necessary work. He says that thirty per cent of the Ph.D.'s currently granted are in the sciences, which fraction he believes is already too large. Thus it may be that the new pressure of competition always created by a government subsidy will be felt here also. The Board has power to investigate the overall effects of its program; it may be possible for the Board to find an effective solution to this problem by judicious evaluation of facts gained in such investigations.

As we mentioned before, the N.S.F. cannot interfere in the research activities of other government agencies. It does, however, have the power to evaluate such activities, and to coordinate them with each other and with work of private laboratories. There is no reason that the private laboratories should dislike this; true basic research is of value to all regardless of its source. Another connection with other government laboratories is found in the procedure suggested in the law whereby the heads of agencies can allocate funds originally given them to the N.S.F. so that it can do the research instead. It is to be exepcted that this will be a rare occurrence, especially when the facilities for the piece of research are already in the possession of the agency. Also, the Secretary of Defense may ask that certain military research projects be carried out with N.S.F. funds, although the amount of this too should not be significant, because of the large research offices already in the National Military Establishment.

In order to effectively carry out the aims of the law, the Foundation is charged with some minor duties. Among these is the maintenance of the nationwide list of technical and specialized personnel now in the possession of the United States Employment Service. Another duty is to foster the interchange of foreign scientific information. For instance, the German patents acquired in the war might well have been administered by the N.S.F., had it been in existence at the time.

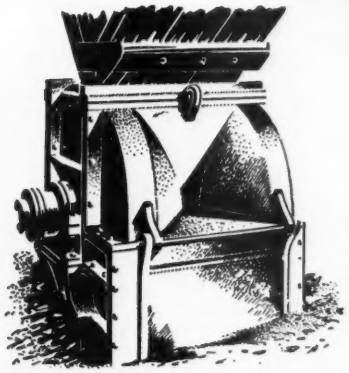
There is one clause in the law which restricts the policies of the Foundation in a fairly general way. The Board must make every effort to avoid the concentration of benefits among only a few recipients. It must try in every case to spread the aid among the smaller laboratories as well as the large ones. It is plain that the first Board will have many tough problems of policy. The men on that Board will be setting the precedents; if they succeed, we may see the evolution of a powerful organ of science which will be helpful but not obnoxious.

order out of chaos

(*Continued from page 26*)

virtually controls our industrial giant, telling him what to do, and in what direction to go. Even more important is it that every future engineer knows and appreciates the Industrial Designer, for he will spend the rest of his life working alongside this man, producing things which are good looking as well as mechanically perfect.

Another page for **YOUR BEARING NOTEBOOK**

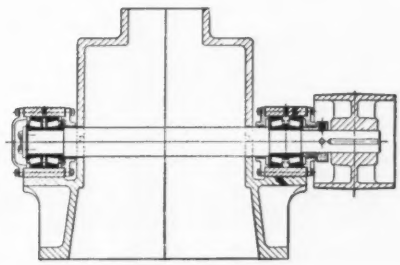


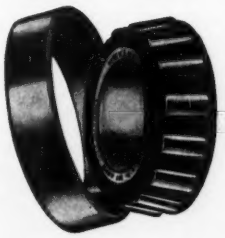
How to improve a wood hog's appetite

The wood hog shown here chews up logs for paper pulp like a giant pencil sharpener. As they chip away at the logs, the revolving cutter knives impose heavy shock loads on the bearings. To carry these shock loads, engineers specified that the cutter shaft be mounted on Timken® tapered roller bearings. Due to the line contact between the rolls and races, Timken bearings have extra load carrying capacity —take the heaviest shock loads.

Here's how engineers use TIMKEN® bearings for heavy shock loads

To give extra support to the wood hog's main shaft, double-row Timken bearings are used. The tapered construction of the rolls and races enables Timken bearings to carry both radial and thrust loads in any combination. Shafts are held in rigid alignment, end movement eliminated. Because Timken bearings permit the use of effective closures, lubricant stays in and dirt and moisture are kept out.





TIMKEN

TAPERED ROLLER BEARINGS

Want to learn more about TIMKEN® bearings?

Some of the important engineering problems you'll face after graduation will involve bearing applications. If you'd like to learn more about this phase of engineering, we'll be glad to help. For additional information about Timken bearings and how engineers use them, write today to The Timken Roller Bearing Company, Canton 6, Ohio. And don't forget to clip this page for future reference.

NOT JUST A BALL ○ NOT JUST A ROLLER ⬭ THE TIMKEN TAPERED ROLLER ⬭ BEARING TAKES RADIAL ◐ AND THRUST —◐— LOADS OR ANY COMBINATION ✳

You can
AFFORD to use
CASTELL
world's finest drawing pencil
with Genuine IMPORTED
CASTELL lead NOW!
Why wait until you graduate? Start using the Drawing Pencil of the Masters today—smooth, free-flowing, grit-free CASTELL, accurately graded in 18 unvarying tones of black, 7B to 9H.
YOU CAN AFFORD CASTELL—because it outlasts other pencils, hence is more economical. In addition, you get the personal satisfaction of superior craftsmanship that only CASTELL gives. Unlike ordinary pencils, CASTELL sharpens to a needlepoint without breaking.
Ask for CASTELL at your book store. Don't allow yourself to be talked into using a substitute. CASTELL is a life-time habit for up-and-coming Engineers.
A.W. FABER CASTELL USA 9000 H
AW FABER-CASTELL

briefing the news

Mapping of Space Charge Field of Magnetron . . .

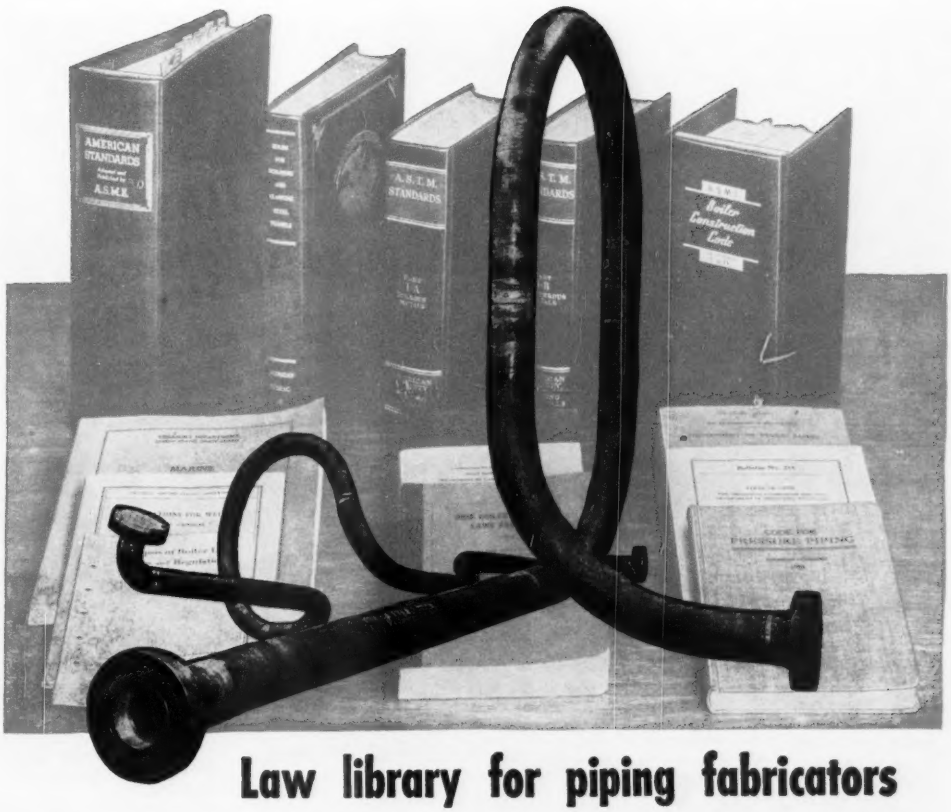
The new method for mapping the space charge density and electric field distribution within a magnetron is a modification of the electron optical shadow technique developed for quantitative study of minute electric and magnetic fields.

A magnetic lens is used to produce shadow images of two fine wire screens placed at either end of the magnetron in the path of an electron beam. Then from the distortion in the shadow network caused by deflection of the electron rays as they pass through the magnetron field, the radial electric field is computed. These results are used to obtain the space-charge distribution.

The high space-charge density within a magnetron is known to have an important bearing on performance. However, very little is actually known concerning the electric field distribution and space charge configuration within the tube. Theoretical solutions have been hindered by the formidable mathematics. Experimental determinations have failed because previous methods disturbed the critical symmetry of the field under study.

The new method uses an electron beam as a probe but keeps the charge density of the probe beam small compared to the space charge in the magnetron. The field under study is undisturbed. An electron gun sends the beam axially through the tube. Coaxial coils surrounding the magnetron provide a homogenous magnetic field for the operation of the magnetron and at the same time act upon the beam as a convergent magnetic lens, bringing it to a focus beyond the tube. Two fine wire screens are placed in the path of the electrons, one just in front of the magnetron, the other just beyond the back focus of the beam. A complex shadow pattern due to the two wire screens is then formed on a fluorescent screen. When the d.c. potential across the magnetron is zero, the pattern is undistorted. However, when an electric field is applied to the magnetron the shadow network on the fluorescent screen becomes quite distorted and theoretical analysis of this effect has related the distortion of a given part of the pattern to the intensity of the electric and space charge fields in the corresponding region of the magnetron. The results given by this method differ considerably from those predicted by theorists.

This method is also well suited to investigations of electron optical lenses, gas discharges and other space-charge problems. (*Continued on page 38*)



Law library for piping fabricators

The safety of employees, the welfare of the community and a major investment can depend on a single piece of prefabricated piping. That's what piping codes are for . . . state, national, association and insurance codes. Grinnell engineers know the "law" intimately, check and cross-check with these codes at every step from preparation of detailed drawings and specifications right through bending, welding, stress relieving, heat treating, final inspection, assembly and test runs.

That's just one of the many advantages of having a piping system prefabricated by Grinnell.

The complete "package" includes interpretative engineering, metallurgical research, compliance with code requirements, manufacturing drawings and specifications, production schedules, purchase of materials, specialized facilities, skilled personnel, control of quality and rigid inspection.

Such knowledge and careful attention to all requirements of simple or complex jobs is typical of Grinnell's complete piping service which provides the products, facilities and service required "whenever piping is involved".

Grinnell Company Inc., Providence, R. I.

GRINNELL

pipe • valves • Grinnell-Saunders diaphragm valves • pipe and tube fittings • welding fittings • engineered pipe hangers and supports prefabricated piping • Thermolier unit heaters • plumbing and heating specialties • industrial supplies • water works supplies Grinnell automatic sprinkler fire protection systems • Amco humidification and cooling systems

ENGINEERING GRADUATES HAVE FOUND ATTRACTIVE OPPORTUNITIES WITH GRINNELL.

The Modern Uni-Pull Drive
UNIFORM PULL AROUND THE PULLEY
Modern Flat Leather Belt
UNIFORM PULL ACROSS THE PULLEY
Tension Controlling Motor Base
LEATHER PLUS PROPER TENSION Gives Continuous, Dependable Service
An ordinary trouser's belt is an everyday reminder of the continuous, trouble-free service leather plus proper tension can give.
Modern power transmission uses these same two ingredients in the Uni-Pull drive. Uni-Pull teams a modern flat leather belt with a tension-controlling motor base and gives today's industry a flexible, compact, long service drive . . . a drive that makes the most of the inherent power-carrying advantages of leather.
American LEATHER BELTING Association
Headquarters for Authentic Power Transmission Data
41 PARK ROW, NEW YORK 7, NEW YORK
AL 47

ENGINEERS' CHOICE for ACCURACY and DURABILITY!
LUFKIN
"WOLVERINE"
CHROME CLAD
Engineers Steel Tape
Assures A Longer Life Of More Accurate Measuring
• Non-glare Chrome-Clad satin finish on line—extra durable, will not crack, chip, peel, or corrode.
• Permanent jet black markings, prominent size aids easy and accurate reading—graduations extend to edge of line.
• Sturdy ½-in. line, fully subdivided, "Instantaneous" Readings . . . detaches and attaches easily to reel.
• Super-strong rustproof metal disc reel with perforated sides to aid in cleaning and drying.
• Adjustable leather strap handle affords firm hold . . . long winding handle, line-locking type.
• Supplied with two improved pattern, removable finger rings. Ring locks under spring protecting first end.
In 50, 100, or 200-ft. lengths, marked feet, 10ths and 100ths, or feet, inches and 8ths . . . standard and extra-heavy models. See them at your nearest Lufkin dealer.
Buy LUFKIN TAPES • RULES PRECISION TOOLS
96-A
THE LUFKIN RULE CO.
SAGINAW, MICHIGAN • NEW YORK CITY • BARRIE, ONTARIO

briefing the news

(*Continued from page 36*)

Reverse — in Four Milliseconds . . .

Designed specifically to meet the need for high-speed reversal of magnetic tapes in the memories of electronic/digital computing machines, a technique for reversing small electric motors in three to four milliseconds may prove useful in many other applications. The motor shaft is rigidly connected with one end of the torsion bar, which is equipped at the other end with two positive unidirectional clutches. One clutch prevents clockwise, the other counterclockwise rotation. If the motor is in rotation in a clockwise direction and the proper clutch is engaged, the adjacent end of the torsion bar is stopped. This brings the rotor to a stop in approximately twenty degrees. The potential energy stored in the torsion bar is then returned to the rotor in the form of a counterclockwise impulse enabling it to attain virtually full speed in the new direction in about two milliseconds.

Robot Lightship . . .

The first robot lightship built for ocean duty will soon be put into trial service in New York harbor. With the aid of a remote control system a single operator at the Sandy Hook, New Jersey, Coast Guard Station will have complete control over the lightship's signalling system.

One of the ship's three generators will be in continuous operation; the other two will be held in reserve. These supply power for the lights, radio beacon, and fog signal. The controls for the light and other devices are actuated by short waves through a receiver and relays. There is a warning system consisting of a flashing light and an audible signal.

Aluminum melts at 1217° F....

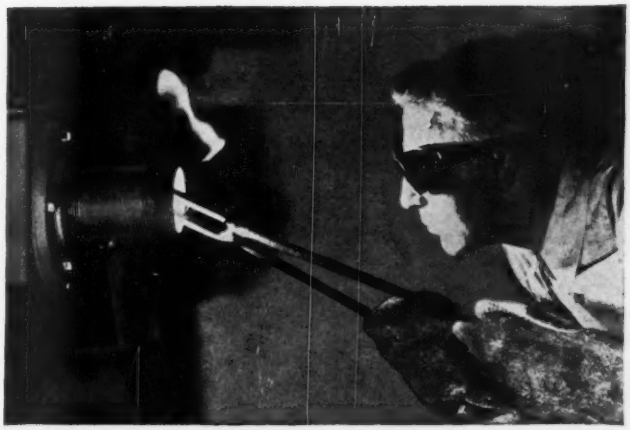
What's the melting point of fused aluminum oxide?

- ☐ *1652°F.*
- ☐ *2732°F.*
- ☐ *3272°F.*
- ☐ *3722°F.*

Not 1652°F. which is a bright red heat; nor 2732°F. which is white heat; nor 3272°F., the highest temperature in a blast furnace.

Yes, the melting point of fused aluminum oxide (as made by Norton from the mineral bauxite under the registered trade-mark Alundum) is 3722°F. That's why it's such a popular refractory material. Because it also possesses high thermal conductivity and low electrical conductivity when hot, it is used extensively in both fuel and electrically heated furnaces.

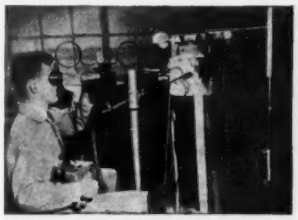
In the Norton Mechanical Laboratory W. M. Wheildon, Jr., B. S. and M. S., Massachusetts Institute of Technology '30 and '31, takes readings on a wear-testing machine which he developed.



Harder Than Cemented Tungsten Carbide

Alundum grains in various crystalline structures are widely used as abrasives. On the Knoop scale, they have a hardness of 2000, the same as the sapphire.

As the world's largest manufacturer of abrasives, Norton has worked wonders with Alundum grains. Highly skilled, college-trained research men in Norton's laboratories have succeeded in giving to Alundum abrasives a wide range of physical properties by controlling the size of crystals and their chemical and physical properties.



In the Norton Ceramic Laboratory O. J. Whittemore, Jr., B. S., Iowa State '40, operates a load test furnace of his design — a furnace that tests refractories at temperatures up to 2450°C.

32 Alundum Abrasive

The crowning achievement in aluminum oxide chemistry was the creation by Norton of a unique single-crystal grain structure of unusual sharpness. Named "32 Alundum," it has been hailed as the "greatest abrasive contribution to increased grinding production in more than 40 years."

Remember Norton

There is a bright future in the abrasive industry for young engineers whose talents run in that direction. Remember that Norton is dedicated to "making better products to make other products better."

NORTON

TRADE MARK REG. U. S. PAT. OFF.

Making better products to make other products better

ABRASIVES · GRINDING WHEELS · OILSTONES · ABRASIVE PAPER & CLOTH

GRINDING & LAPPING MACHINES · LABELING MACHINES · NON-SLIP FLOORING

REFRACTORIES · CERAMIC SURFACE PLATES · BORON CARBIDE PRODUCTS

NORTON COMPANY, WORCESTER 6, MASSACHUSETTS

BEHR-MANNING, TROY, N. Y. IS A DIVISION OF NORTON COMPANY

THE DU PONT DIGEST

Chemical Research helped produce *Better Tires For You*

The tires on your car right now may have cords of Cordura* High Tenacity Rayon yarn. If so, you benefit from one of the most important contributions that Du Pont scientists have made through the years to the automotive industry.

"Cordura" High Tenacity Rayon is comparable to structural steel in tensile strength. It makes possible tires that are at once lighter, stronger and safer than pre-war tires. Unlike natural fibers, the qualities of this product of chemical science are always uniform.

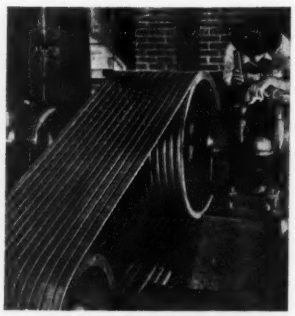
UNDIES TO TIRES

At first, rayon was used mainly in making articles of clothing. However, with an improved tire cord in mind, Du Pont scientists set out to produce a tougher rayon than any previously known. The problem was given to a skilled team whose members included organic, physical and analytical chemists, physicists, and chemical and mechanical engineers.

One of their first discoveries was that strength could be increased by using cotton linters as the source of cellulose, in place of wood pulp. It was found, also, that the viscose solution had to be prepared and handled with extreme care. Perhaps the most important lesson was one which the silkworm had taught centuries before: *stretching increases strength.* The Du Pont experimenters stretched the new yarn and made rayon with a tensile strength of about 70,000 pounds to the square inch—more than twice the strength of textile rayon then being produced.

TRIED AND PROVED

With the cooperation of tire manufacturers, "Cordura" was tested in heavy-duty tires on baking-hot desert roads. During the war it proved itself on command cars, trucks and jeeps. Today, rayon-cord tires are widely used on trucks and buses, and leading manufacturers use Du Pont "Cordura" in tires they make for passenger cars.



V-belts of "Cordura" and rubber keep even tension, far outlast others.

The combination of lightness and strength offered by "Cordura" has also earned it a welcome from makers of conveyor belts, V-belts and hose for domestic, agricultural and industrial uses. It is used to reinforce laminated kraft paper, to tie wires to electrical switchboards and as a chain warp in carpets to bind the wool tufts firmly in place. One of the newest uses is in plastic clotheslines. The Du Pont Company makes none of these articles. But because Du Pont scientists had an idea and the facilities and funds to develop it, many businesses can now offer you better products to make life safer and more enjoyable.

*REG. U. S. PAT. OFF.

SEND FOR "The Story of Cellulose," a 43-page, illustrated booklet that describes the making of viscose and acetate rayon, lacquers, plastics, coated fabrics, etc. Many charts and equations. For free copy, write to the Du Pont Company, 2503 Nemours Building, Wilmington, Delaware.

DU PONT
REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING
...THROUGH CHEMISTRY

Great Dramatic Entertainment—Tune in "Cavalcade of America" Tuesday Nights, NBC Coast to Coast

Photography can make this page

this small

IT'S DONE WITH MICROFILM MAGIC

TINY AS IT IS, the little rectangle above is this page in black and white—as it appears on microfilm. Everything there, condensed to a mere spot, but ready to be brought back full size with all its features intact. For photography can reduce tremendously without losing a detail.

As a business or professional man, you can utilize photography's reducing ability in any of many important ways.

You can utilize it to save space . . . to speed reference. With Recordak microfilming, you can "debulk" files 99% . . . keep the records at hand for quick viewing, full size, in a Recordak Reader.

You can utilize photography to make sales presentations more complete, more resultful. With motion pictures, you can "pack" a plow, a plant, a whole process into a small can of film . . . travel it where you will, show it off "large as life" and much more dramatically.

Only a suggestion . . . this . . . of what photography can do because it is able to condense. And because it has many other unique characteristics as well, photography is becoming an increasingly important tool all through science, business, and manufacturing.

Whenever you want to improve methods of recording, measuring, testing, teaching, or countless other functions, be sure to consider the unusual abilities and advantages of photography.

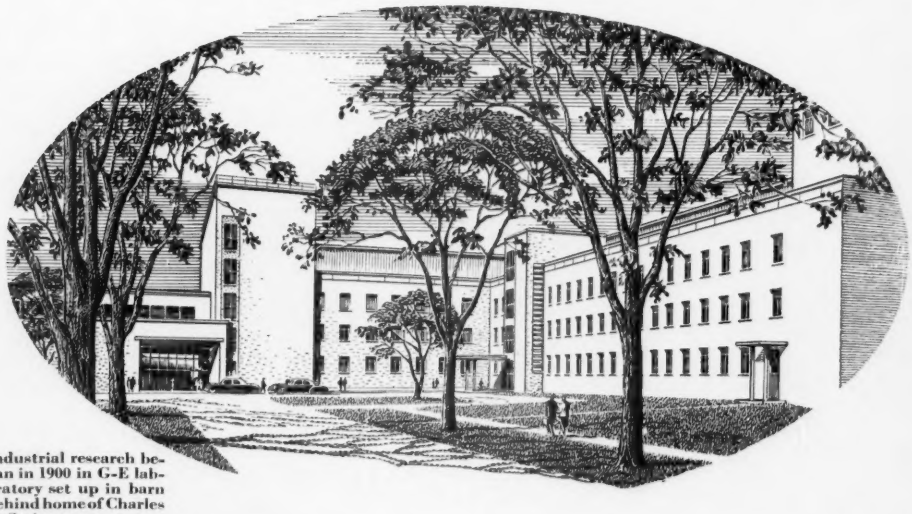
Eastman Kodak Co., Rochester 4, N. Y.

Functional Photography

—is advancing business and industrial technics.

Kodak
TRADE-MARK

50 YEARS of General Electric Research



Industrial research began in 1900 in G-E laboratory set up in barn behind home of Charles P. Steinmetz.

When the General Electric Research Laboratory was established in 1900, it was the first industrial laboratory devoted to fundamental research.

At that time E. W. Rice, Jr., then vice president of General Electric, said:

Although our engineers have always been liberally supplied with every facility for the development of new and original designs and improvements of existing standards, it has been deemed wise during the past year to establish a laboratory to be devoted exclusively to original research. It is hoped by this means that many profitable fields may be discovered.

Many profitable fields *were* discovered—profitable not only for General Electric but also for industry, the American public, and the world.

A half century ago the industrial experimental laboratory was itself an experiment. This month it begins its second half century with the dedication of a new building, greatly augmenting the facilities it offers to the advancement of man's knowledge.

You can put your confidence in—

GENERAL ELECTRIC